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Plastic silo (left) with reinforced concrete model

Plastics in Farm Building page 163

Agriculture

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D. B. Wallace
of Cambridge University
discusses the implications of

'The Structure of Agriculture'

It is one of the strange facts about our knowledge of British agriculture that, while we know a good deal about the total acreages of crops and numbers of livestock by counties from the Agricultural Census, which has been running for a century, and from the writings of men like Vancouver, Young and Cobbett before that, yet we know precious little about the most important members of the industry, the farmers themselves, and how they organize their holdings.

We do not even know how many farmers there are, for the census refers to *holdings*, several of which may make up a *farm* in certain cases. Again, some men may operate a number of farms in different parts of the country. Anyway, what is a farmer? A man with five acres and a few cows will certainly make a census return, yet can he honestly be regarded as a farmer? Even the Registrar-General's decennial census is not much help here, for it relies on self-classification by respondents. A wealthy man who farms and has another job as well, may decide that the latter is his main source of income and so classify himself.

Background

Now, with the publication by the Government of *The Structure of Agriculture*,* we are beginning to get a clearer idea of the pattern of farms that make up our industry, and perhaps as important, how many there really are. This report continues a process that actually started with the Small Farmer Scheme in 1959, when holdings were classified by both acreage and the labour content of their cropping and livestock numbers. There the idea was proposed that a farm should be any holding that was not only over 20 acres in size, but also had enough labour requirement to justify at least one man working full-time upon it. This proposal was regarded by many as very novel, but was accepted on its sheer logic, provided always that the measure of labour used, the Standard Man-Day (smd), and the level regarded as providing for full-time employment, did not rule out genuine small full-time farmers. An investigation reported by two Ministry of Agriculture economists, Ashton and Cracknell, satisfied doubts upon this score. It was found that, of the 370,000-odd holdings, about 180,000 failed to qualify as full-time farms, yet further investigation of these disclosed

**The Structure of Agriculture*. H.M. Stationery Office. 3*s*. 6*d*. (by post 3*s*. 11*d*.)

that only about 10,000 were operated by men who had no other source of income. So it would seem well established that the number of full-time holdings, but perhaps not farmers, is now known.

Further progress was made later in dividing the full-time holdings into three sub-classes, small, medium and large, coinciding, respectively, with family-type holdings which could employ one or two men effectively, those with a need for up to four, and the really large commercial units with a need for more than four men. In the last two White Papers on the Annual Price Review, these categories have been used to analyse the proportion of output that comes from the various classes, indicating where policy decisions would have most impact on the pattern of production.

The present position

The Structure of Agriculture continues the process and analyses the current pattern of our farms in two ways, by size of business, as measured in smds, and also by type of farm organization practised. The first is of general interest only and, rather surprisingly, shows that there is relatively little difference between the four countries making up the United Kingdom so far as the proportion of the different size-groups is concerned. This can be seen from the following table.

Proportion of holdings in U.K. in each size-group

(Percentage—June, 1965)

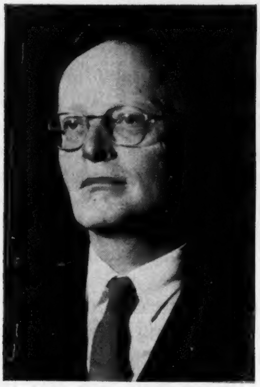
Size-group	*England*	*Wales*	*Scotland*	*N. Ireland*
Large	13	3	12	2
Medium	18	14	16	8
Small	21	27	15	46
Very small	48	56	57	44

Apart from the special conditions in N. Ireland, which gives a bias at the smaller end of the scale, the pattern is much the same in each country, with about half the holdings less than full-time and the other groups containing roughly equal numbers, though Wales, like N. Ireland, has very few big farms.

The second stage of the analysis is perhaps the most interesting, for it tells us much more about the way these full-time farms are organized. For each country, the returns have been classified by major farming types. As might be expected, the actual details of the classification have varied between the countries, for their agricultures are different. But, even so, some important points emerge.

Dairying is shown to be the main type of farming in all four countries, being over 40 per cent of the total in all except Scotland, where it forms nearly one-third. There is no particularly clear-cut runner-up. The remainder are more or less evenly divided amongst several types, though cropping farms are obviously more important in Great Britain than in N. Ireland. Perhaps the point with the greatest implications is the attempt made to estimate the financial significance of this classification. Data derived from the annual survey of farm incomes has been classified in the same way as for the census data, and the financial results applied to the appropriate groups by size and type, where sufficient data exists to be meaningful. This

gives a starting point when considering the effect of future financial movements upon the structure of agriculture.



THE AUTHOR

After taking degrees in agriculture and economics, **D. B. Wallace, M.A. (Cantab.),** was in the Provincial Agricultural Economics Service until 1963, when he took up his present appointment as Gilbey Lecturer in the History and Economics of Agriculture at Cambridge University. He is especially interested in research into social policies for agriculture, particularly the impact of industrialization on the countryside.

Immediate implications

The distribution by size shown in the table above suggests, in future, policy should be aimed mainly at the 50 per cent or so of holdings which provide a full-time living for the occupier, and that we should cease to treat agriculture as a single entity embracing every unit in the census. This pattern has already started with the Small Farmer Scheme, and could well be continued when other support methods are being discussed.

The level of incomes shown in the analysis by type of farming suggests that large numbers of our farmers are making very small incomes, even though they are full-time operators. Much depends upon the level of income that is regarded as a bare minimum, but perhaps £1,000 per year is a fair figure. The tables in the report show the weighted *average* incomes made by the actual farms in the management survey. If it is assumed that the farms in the census made a range of incomes equally dispersed about these averages, then it can be assumed that half the farms in any group made less than the average and half more. Now the average income for the smallest (one or two men) size group in almost every class in each country was below £1,000. The only exceptions were the cropping and mixed classes in England and Wales, and cropping class in Scotland. So that apart from mainly cropping farms, it can be said that at least half the others make less than £1,000 per year. This gives an estimate of 34,000 full-time farms as making less than this level, which poses a considerable problem for future policy-makers. How this should be solved cannot be discussed in detail here, but any programme must include planned adjustment and amalgamation schemes. But this is not the whole of the picture. Several of the other groups make average incomes of only just over £1,000 per year. If a proportion of these is added, the total increases to 42,000, and this makes no allowance for the larger size-groups. The average income in these groups is well above the £1,000 level, but they must contain some members who make less. Therefore this figure must be a conservative estimate of the problem.

Implications for the future

Limitations of space prevent more than two points relevant to the future pattern being discussed here, but both are likely to lead to further problems for policy-makers. First, whatever the political future, the market for liquid milk in this country is not likely to expand as fast as the rise in individual farmers' productivity. Therefore pool prices are not likely to increase, at least in 'real' terms. (They may increase to take account of inflation, but only in step with the falling value of money). Hence the return to dairy farmers will be under increasing pressure, unless there is a radical reduction in their numbers. The proportion of dairy farmers is not only the highest of any type of farm already (as discussed above) but, except in Scotland, there are also a disproportionate number of them in the smallest size-group who are already averaging less than £1,000 net income. This very large number of farmers with a difficult future will pose a big social as well as economic problem.

The second point concerns the possibility of entering the common market. On the whole, if the level of prices adopted or now ruling in the common market were to obtain in this country, it would mean that while cereal growers would benefit substantially, livestock farmers who now rely to a large extent on cheap grain—especially the pig and poultry producers but probably also dairy farmers—would face conditions of lower profitability because of increased feed costs. Growers of horticultural crops which now enjoy a high level of protection against competition from imports would also face problems. Therefore entry into Europe would pose an even greater need for change amongst almost all types of farming than if we stay out, though the end result might very well mean an increase in net income for home agriculture as a whole.

Contra-rotating Drums for cutting grass

David J. Evans

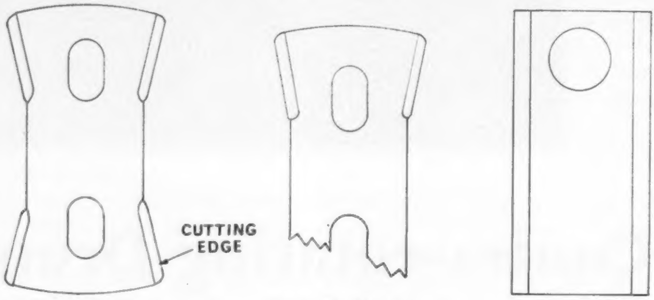
For over a hundred years the fingerbar mower has been used on farms in this country, but present trends indicate that its days may be numbered. A revolutionary type of rotating-drum mower has emerged in the last two years, and has shown considerable promise. This type of machine, produced under a Dutch patent, was offered for sale in this country for the first time during 1966 and is now available from three manufacturers. The machines made by each of these firms are basically similar, although they have minor differences.

Cutting mechanism

The machines have a working width of 5 ft, and produce a double swath. The cutting mechanism consists of two pairs of contra-rotating drums, each of which revolves about a vertical axis. Each drum carries two blades, which are free to rotate in a horizontal plane about pivots when obstacles are encountered. The method of attachment and the design of these blades has developed over the last two years. One of the earlier types was a four-edged blade, with a hole at each end of the blade for attachment. As each face became worn, the blade could be turned round on the pivot so that the

diagonally-opposite edge could be used. When this face became worn, the blade could be changed on to the adjacent drum, so that the other two edges could be used.

With this type of blade, breakage across the attachment hole not in use was fairly common in stony conditions. Another disadvantage was that the fitting hole at the cutting end of the blade tended to be distorted during work, which prevented a proper fit over the cleat when it was changed round.



Four-edged blade with two fitting holes

Four-edged blade broken across the second fitting hole

Two-edged blade with single hole

Improvements were made, firstly by using a more malleable steel, and then by making the blades with the fitting hole at one end only. This reduced the number of cutting edges to two, but strengthened the blade considerably.

One type of blade-mounting consists of a fairly complex floating blade carrier which is centrifugally self-balanced, so that at the working speed of 3,000 r.p.m. the blade is held a certain distance out from the drum. If the blade hits an obstruction, the whole mechanism breaks back. This mechanism has given a certain amount of trouble in some conditions; carrier arms sometimes disintegrate due to lacerated grass blocking the linkage and causing the arms to hit the adjacent drums. It is largely for this reason that the fixed pivot system, which was used with considerable success last season, will in future be used for blade attachment. Here, each blade is positively located, but is free to revolve on its pivot when an obstacle is encountered. Fitting of blades is effected by means of a simple tool.

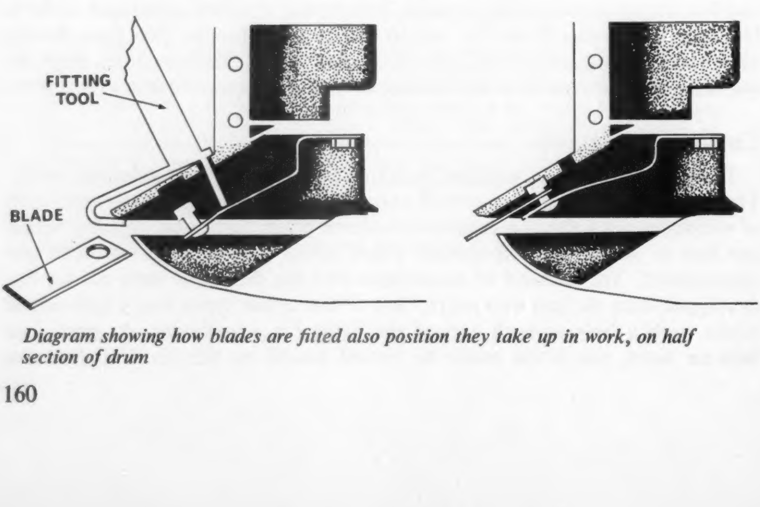


Diagram showing how blades are fitted also position they take up in work, on half section of drum

Rates of work

Overall rates of work vary from about two to three acres per hour depending on tractor power and crop density. Except in very light crops, it seems unlikely that speeds in excess of 7 m.p.h. will be achieved because, with the belt drive arrangement adopted at present, the rate of work is limited by belt slip on the machine rather than by tractor power.

As would be expected, laceration only appears to occur at the bottom of the crop where cutting takes place, and this may amount to pulping of the material. There is some evidence that the degree of laceration depends partly on the forward speed of the tractor in relation to the power take-off shaft. With a constant p.t.o. speed, slow forward speeds give rise to a greater number of revolutions of the drums per foot of travel, and this increases the degree of laceration. Increased laceration also results from shortening the top link and thus increasing the tilt. Since laceration only affects a very small proportion of the crop, its presence is probably of little significance. It is very important that engine speed is kept constant so as to maintain 540 r.p.m. at the p.t.o., which gives a drum speed of 3,000 r.p.m. If the speed is reduced appreciably, very ragged cutting occurs.

Advantages over fingerbar mowers

Forward speeds are probably not much higher than those attained with fingerbar mowers, but rates of work in acres per hour are likely to be considerably greater, especially in heavy or laid crops. Blockages appear to be

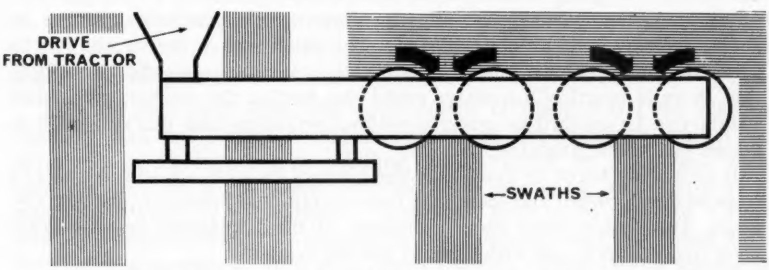


Diagram to show direction of rotation of the drums, and disposition of the swaths —plan view

virtually unknown and, given reasonably stone-free conditions, blade changing is infrequent. With fingerbar mowers, farmers find that too much of a skilled man's time is required to sharpen knives. With four-drum rotary mowers, no sharpening is needed, blades are expendable and cost about 3*s*. each.

It has been established from work at the National Institute of Agricultural Engineering that swaths cut by fingerbar mowers are less susceptible to deterioration by extended periods of wet weather than those produced by flail mowers, where such losses vary with the degree of laceration. This may also be a point in favour of rotary mowers since, with these, laceration is slight, providing a better insurance against the unpredictable weather conditions that prevail in this country. Criticisms of rotary mowers have so far been mainly concerned with breakages of blades and blade-locating arms but improvements made during last season eradicated some of these troubles.

Nevertheless, regardless of the quality of steel used in the blades and of the methods of blade location employed, the types of breakages which occurred last season can be reduced considerably by rolling surface stones into the ground with a heavy roller early in the season or, if necessary, by hand-picking and removing larger ones from the field. If these mowers are to be used to the best advantage, this prerequisite should be considered essential.

Effect on wilting

With the limited amount of work done so far it is not possible to be positive, but there is evidence to suggest that the conditioning effect of four-drum rotary mowers is of little significance and results in little, if any, increase in wilting rate. However, there may be some advantageous effect on wilting due to the smaller size of the swaths cut by four-drum rotary mowers. It is known that small lacerated swaths have a faster drying rate than larger ones with the same degree of laceration, and this could also be true of unlacerated swaths. Further research work is needed.

For and against

Four-drum rotary mowers show great promise, particularly because many of the disadvantages of fingerbar mowers are overcome. Blocking in laid crops is a rare occurrence, the blades are expendable, and no sharpening is needed. At the stage of development reached by these mowers during the 1966 season, blades tended to break frequently in stony conditions. Rolling the land in the spring should help to solve this problem.

Work done so far suggests that the slight conditioning effect caused by rotary mowers is of little significance. The small size of the swaths left by four-drum mowers may, however, have a slight advantageous effect on wilting rate. A valid practical advantage could also be that the smaller, evenly-laid swaths can be crushed or crimped without wrapping and blocking such as occurs behind reciprocating mowers.

It should be borne in mind that these rotary mowers are still at an early stage of development and there may be considerable advances in the next few years. This article gives some indication of the advantages and disadvantages likely to be found with those at present available.

The photograph on page 159 was taken in Germany and as shown the mower does not comply with British Safety Regulations; arrangements are in hand to guard such machines before they are offered for sale in Britain.

The author of this article, **David J. Evans, B.Sc.(Agric.), N.D.A., N.D.Agr.E.,** is a Cornishman who took his degree at London University and later worked in France as a technical representative for an engineering firm before joining the N.A.A.S. in 1964. He is now a Mechanization Adviser in the West Midlands, and he carried out a survey of rotary mowers in that area in the summer of last year.

LORD WILLIAMS of Barnburgh

An appreciation of the late Lord Williams will appear in the May issue of *Agriculture*

Plastics in Farm Building

F. W. Holder

IT DOES not seem so long ago since the word 'ersatz' was used in a derogatory sense to describe objects made of material not hewn from the earth or taken from animal or vegetable sources. To use such man-made materials suggested that the users were lacking in natural resources and were therefore to be pitied or despised, according to taste. Today, in some spheres of activity the reverse appears to be the case, as traditional materials are being rejected increasingly in favour of the new ones. 'Plastic' is now substituted for 'ersatz', thereby providing a more respectable connotation. The vast and ever-expanding plastics industry is evidence in itself of the present trend, and its products and activities cover every section of our modern existence.

Early developments

As with most new ideas, the development of plastics and the plastics industry had its origin in Britain, when, in 1865, Joseph Parkes of Birmingham discovered that cellulose nitrate could be plasticized with camphor to form a mouldable material which hardened, on cooling, to a horn-like product. This he named 'Parkesine', later to be renamed 'Celluloid', the first man-made thermoplastic. Development work continued both in Britain and abroad, until 1916 when the first thermosetting moulding powder, 'Bakelite', was produced on a commercial scale in Germany. This was made by heating phenol with formaldehyde. Since then, as is well known, a wide variety of other chemical products have been brought into the field of plastics, and their number is constantly increasing.

There are two main types of plastics, thermosetting plastics and thermoplastics. The former retain their form and do not soften when heat is applied, whilst the latter will soften (and sometimes melt) under heat but will harden again on return to the original temperature. Both have many applications to modern farm buildings and fixed equipment.

First use in agriculture

The first member of the plastics family to be used in agriculture was a transparent sheet material, corrugated like asbestos cement or galvanized steel sheeting. This material was used during the last war for the hoods of the 'Mosquito' bombers and when peace came it was adapted for the roofs of barns and cowhouses. Since those days a wide range of transparent plastic

sheets of similar profile and differing constituents have appeared on the market. They have, to a great extent, superseded glass, because they are not brittle and can be married in with standard cladding sheets cheaply and effectively. Opaque sheeting is also made in a variety of 'fast' colours, which can be used effectively, when matching traditional materials or in areas of scenic beauty where planning considerations require special treatment.

Insulation and sheeting

Some types of modern farm buildings in which stock are housed, require special attention to be paid to environment, and here plastics have a wide application when used for insulation in the construction of these buildings. 'Polystyrene', 'Polyurethane' and 'Expanded P.V.C.' are household words in this regard. All have the advantage of a high insulation value and extreme lightness in weight, making handling easy. They can be applied as slabs or sprayed on to walls, ceilings and roofs. The lightness of these products makes them especially attractive when used in the construction of refrigerated stores, where they have largely superseded cork as an insulant. Cork has to be imported into this country, whereas the plastics do not.

Where insulation is used, its effectiveness is apt to diminish if it is placed in contact with moisture, either inside or outside a building. Therefore, what are called 'vapour-barriers' must be provided, and here the plastics industry have produced a wide range of impervious flexible types of sheet suitable for many uses. 'Polythene' and 'P.V.C.' are names which come to mind. These sheet materials can be used for such purposes, as linings to dams and reservoirs, damp-proof membranes under floors and in basements. Plastic sheeting of this kind is also used widely to make containers for grain, farm and horticultural produce and as a covering to silage silos. Transparent polythene sheeting, has, in recent years, played an increasing part in speeding winter construction, by enabling buildings to be enclosed temporarily, so that in the absence of permanent roofs and walls, work need not be discontinued during inclement weather.

Filon 210 translucent rooflights used in an 'Atcost' warehouse at Beverley, Yorks. The chequered distribution ensures an even shadow-free light

Pipes and wiring

Nowadays, nobody thinks of field water supplies in terms of screwed metal piping. A reel of plastic pipe is run out, above or below ground, and special plastic fittings are available for joints of all kinds. Inside the buildings, plastic piping with well-designed screwed fittings, traps and wastes, complete all the plumbing that is needed. Add to this plastic water storage tanks, drinking troughs, water bowls, basins and buckets and one has the whole range of water supply facilities. And, if milk has to be conveyed from parlour to dairy, transparent plastic piping will do this, enabling the milk to be seen in transit and when cleaning, thus minimizing the risks of dirt particles remaining in the pipe. Plastic piping, incidentally, is more resistant to frost than the metal variety.

Drainage plays an immense part in the farmstead and it is important that whatever method of effluent disposal is adopted, the need to reduce the amount of pollution which might arise from the addition of storm water to uncovered areas, cannot be exaggerated. Plastic gutters and down pipes have been on the market for several years and are available in different weights, sizes and colours. Needing no maintenance such as painting or sealing, they are impact-resistant and flexible. Gutters, for example, loaded with snow, will spring back into shape when it melts. Below ground, plastic drain-pipes, obtainable up to 16 in. diameter and in long lengths, shows signs of superseding the traditional stoneware pipes for this type of work.

In the electrical and mechanical engineering field, plastics are playing an increasing role. 'P.V.C.' covered cable switch-gear casings, fuse and junction boxes, are part of the average farm's installation. Plastic is superseding the rust-prone ferrous metal in conduit. On the mechanical side, plastic bearings are used in pumps and other equipment because they are non-corrosive.

Where exposure to weather brings special problems of maintenance and eventual re-equipment, plastic coated wire mesh and plastic netting (recently introduced) can make a useful contribution to the farm, and the extra cost over ordinary wire may well be justified by the longer expectation of life. Straw bales may now be tied with plastic string!

Finishes and adhesives

Perhaps the most interesting and active section of the plastics industry is the one concerned with adhesives, sealers and finishes. Here there is obviously tremendous scope, especially in relation to the increasing 'industrialization' of building components. Finishes include silicone and other water-repellent treatments, paints, varnishes, either for application to surfaces after erection, or 'built-in' to insulating and other types of wall and ceiling board in the factory. There are also finishes suitable for metal such as plastic coated galvanized steel sheets, and for wood in the form of cupboards and joinery fittings. Among such finishes are epoxy paints which possess outstanding properties of adhesion and resistance to abrasion and chemical action and in wet grain storage silos, for example, provide an effective alternative to galvanizing as a protective covering to metal.

Plastics are successfully employed as a base for many modern glues and adhesives. Modern building techniques, especially where wood and concrete are involved, rely increasingly on adhesives to do jobs which were once done by steel bolts or Portland Cement mortar. Again, reverting back to industrialized building, special care must be taken at the design stage to make the

constructional joints weatherproof and plastics again are in evidence in the sealers and mastics which assist these 'jointings' to perform their proper function.

Tower silos

No study would be complete without reference to the 'package-deal', and the part plastics can play in providing this manifestation of twentieth-century economics. In the manufacture of glued and laminated timber frameworks, the construction of insulated roof and wall panel units, plastics are in common use. Some development work has been done by the Greater London Council on large panel walls of plastic for 'high-rise' flats, and whilst the degree of protection and insulation obtained seem ideally suitable for certain types of livestock housing, the standard of finish and their cost rule them out of the general agricultural field at present. No doubt, in time, something more 'utility' will be developed. The most interesting example of the large plastics unit in agriculture is the tower silo, and one or two firms are in the market with structures which incorporate reinforced plastics of various types. Experience of these structures in this country is limited, although in the U.S.A. they appear to have been used with success for a number of years.

Seek advice

It will be seen from the foregoing paragraphs that plastics are surely, if not superseding, at least offering an alternative to the materials and methods of custom and habit. In some respects they are an improvement. But, as with all new products they must be used with discretion and not forced to do things for which they were never designed. This caution is, for instance, particularly relevant to fire risk. Most plastics are combustible and they must, therefore, be used with care in buildings where inflammable contents are stored, or where there is a possibility that flame will spread from one building or compartment to another. There is also the risk of collapse, under fire conditions, of structural elements which incorporate plastics in their construction or assembly.

These are warnings which could be applied to a wide range of materials as well as plastics, and would appear to underline the need, in this age of rapid technological advances, for professional advice to be sought when planning building projects. 'Do-it-yourself' tactics are all very well once the course has been charted, but to chart it in the first place, requires the help of someone who understands the hazards and can choose the safest and most economical route. This surely is wise investment in the building as in the nautical world.

This article has been contributed by F. W. Holder, B.A. (Arch.) (Lond.), F.R.I.B.A., who has been the Ministry's Chief Architect since 1952, and before then had professional experience in private practice, in local government and in the Ministry of Public Building and Works.

Vining Peas

Plant Populations and Profitability

J. M. King

THE term 'plant population' is probably not very familiar to most farmers or field staffs of processing companies, who are generally more used to talking of seed rate. Plant population is the number of established plants within a certain area of ground, whether it be a square foot or an acre. Seed rate, on the other hand, refers to the amount of seed, and consequently the number of seeds, sown per acre. At present there is a tendency to use a similar seed rate for different varieties of vining peas or for different stocks of the same variety, despite the fact that the number of seeds per pound can vary by as much as 25 per cent between varieties and stocks. In addition, the germination capacity differs between seed samples, and it has been found that the number of seeds and seedlings lost over and above the non-viable seeds can range from 25 per cent in early-March drillings to as little as 5 per cent in those made in May. It is clear, therefore, that a given seed rate seldom results in the same number of established plants in the field. Experience has shown that the average plant population found in vining pea crops is approximately six to eight plants per square foot, with many fields as low as four or five plants. Do these inconsistencies in population matter, and even if they can be eliminated, is the average population found at present the optimum for both yield and profitability?

Population and yield

Research which has been in progress at the Pea Growing Research Organisation since 1962 has proved that there is a very close relationship between plant population and yield in vining peas. During this period a wide range of populations was tested under many different conditions and the summarized results are shown in table 1. The actual yields have been converted to gross return, in £ per acre, using current prices, to allow profitability assessments to be made. The data has been collected from trials carried out on many different soils, including those which tend to produce excessive haulm. Two of the most common vining pea varieties have been used, Kelvedon Wonder, an early-maturing type with moderate straw length, and the maincrop variety Dark Skin Perfection, which has a more robust growth habit.

TABLE 1

Effect of plant population on gross returns

	Population (plants/sq. ft)											
	4	5	6	7	8	9	10	11	12	13	14	15
Gross return (£/acre)	82	88	93	97	99	101	102	104	104	105	105	105
Gross return *less* seed cost (£/acre)	78	83	86	88	89	90	91	92	91	90	89	88

It can be seen that gross return rises quite rapidly as populations are increased from four plants per square foot up to approximately eight plants. There is then a more gradual rise until the optimum gross return is reached at thirteen plants per square foot. These results show an average increase of £17 per acre in gross return as a result of raising populations from four plants to eight plants per square foot and an increase of £23 by going up to thirteen plants per square foot. While yield and gross return per acre are increased as the population is raised, so too is seed cost, and this must obviously be taken into consideration before the optimum population can be found.

THE AUTHOR

This article has been contributed by **J. M. King, B.Sc.(Agric.), M.Sc.,** who is Senior Technical Officer at the Pea Growing Research Organisation's Station at Thornaugh, Peterborough.

Profitability

In this work seed costs were assessed at current prices and it can be seen from Table 1 what happens when these costs are deducted from gross returns. There is still a steady rise in return up to eleven plants per square foot and then, as the higher seed costs offset the increases in yield, there is a gradual decline. The optimum population is shown to be eleven plants per square foot, well above the average populations generally achieved at present. It is significant that the net return declines very much more rapidly at popu-

lations below eleven plants per square foot than at higher populations, which suggests that it is of less importance if the optimum population is exceeded than if it is not reached. Raising the population from seven or eight plants per square foot to eleven plants gives an additional net return of approximately £3 per acre, a very useful increase in profit for any farmer when considered in relation to the number of acres grown and the fact that this will be obtained every year. When populations of four plants per square foot and eleven plants are compared, there is a more dramatic rise in net return of approximately £14 an acre.

The yield and profit increases reported have been obtained in crops where the present fertilizer recommendations have been used. There is, however, the possibility that even greater responses may be obtained with heavier fertilizer applications and it is hoped that work on this subject may soon be undertaken.

Additional benefits

The effect of higher plant populations on yield and profitability is obviously the most important feature of this work, but it has also benefited the grower in other ways. It has been found that as populations are increased so there is a reduction in the straw length and an increase in the percentage of vined peas per cwt of haulm. This is illustrated in Table 2, in which data relating to straw length and the percentage of peas to haulm is presented.

TABLE 2

Effect of plant population on straw length and percentage of peas/haulm

	Population (plants/sq. ft)											
	4	5	6	7	8	9	10	11	12	13	14	15
Mean straw length (in.)	34	32	31	30	30	29	29	29	29	29	28	28
Percentage peas/haulm	16	17	18	18	19	19	20	20	20	20	21	21

The increased yields obtained by raising the plant population from its present level up to eleven plants per square foot are therefore being produced on proportionally less bulky haulm, thus increasing viner throughput and reducing haulage costs. On soils where a large amount of haulm is produced, it has often been found that a population of eleven plants per square foot can give four cwt of vined peas per acre more than a population of eight plants and yet have the same total weight of haulm plus peas. So the higher population increased the yield of peas and reduced the amount of straw, under the very conditions where large amounts of straw can be so troublesome. The less bulky type of straw found under these conditions could account for the fact that there has been no increase in disease, even when populations as high as nineteen plants per square foot have been tested; neither have high populations resulted in 'pale' or 'yellow' peas. Higher populations give an earlier ground cover and increased crop competition against weeds, which can lead to more efficient control from herbicides and also reduces the risk of a second flush of weeds germinating after the herbicide application.

Row widths

Early P.G.R.O. work on row widths showed substantial benefits when these were reduced from sixteen inches to eight inches. Further trials were then carried out to compare eight-inch and four-inch rows, and although a considerable number of comparisons have been made of the same populations grown in each, they have failed to show any significant yield advantage from the very narrow rows. Where seedbed conditions are cloddy, the very narrow rows can even be a disadvantage when drilling. The actual row width used does not therefore appear to be critical, provided it is not wider than eight inches. In all the work on plant population reported, trials were sown in row widths of eight inches or less.

Calculating seed rate

Even when the optimum plant population is known, there is still the problem of achieving it in the field. The variations in seed size, germination capacity and field losses have already been mentioned, and allowances for these must be made in any seed rate calculation if the desired population is to be consistently attained. The following formula for calculating the seed rate to obtain eleven plants per square foot, includes allowances for seed size and germination capacity of the sample:

$$\text{Seed rate in lb per acre} = \frac{\text{479160 (plants per acre)}}{\text{No. of seeds per lb}} \times \frac{100}{\text{\% germination}}$$

Allowances for field losses should be made according to how early or late the drilling is to be. Seed rate should be increased by 20 per cent for drillings made in February, by 15 per cent for those in March, by 10 per cent for those in April, and by 5 per cent for those in May. Heavy or poorly-drained soils have been found to have higher field losses and on these soils the figures can be increased by 5 per cent.

A little time spent calculating seed rates in this way will ensure consistently good stands, and the increased profit will more than repay the effort involved. No farmer can afford crops with populations of four or five plants per square foot, where net returns can easily be £10 per acre below those of the optimum population.

For more information and practical guidance on this important aspect of growing, reference should be made to P.G.R.O. Miscellaneous Publication No. 18, *Row widths and plant populations in vining peas*, copies of which are available on request.

Horticultural Business Records Book

Intensive Cereal Growing Disease Control

Alan G. Walker

INTENSIVE systems of cereal production provide a situation in which cereal diseases thrive. They can contribute to a reduction in yield and in some circumstances cause severe or total loss of crop. With increasing intensification, the avoidance of such losses by limiting the build-up of disease is of primary importance, since the point could be reached where the resulting reduction in yield becomes the most significant factor in determining the profitability of the crop.

Whilst the more spectacular losses have usually occurred in winter wheat, spring-sown barley is also subject to risk, although in the field the effect on the crop may not be so apparent. In some areas disease is now causing a marked reduction in barley yields and should there be an intensification in wheat growing, successive cropping could lead to extensive losses if adequate precautions were not taken to minimize the disease risk.

In intensive systems, where the land may only be free from a susceptible crop for the comparatively short period between harvest and the drilling of the subsequent cereal, soil-borne diseases may gradually increase to a dangerous level. Over the country as a whole, these undoubtedly constitute the major problem. They are not, however, the only risk, and in some areas an expansion of the cereal acreage may be accompanied by an increase in leaf diseases which become epidemic in seasons favourable to infection.

Soil-borne diseases

Take-all (*Ophiobolus graminis*) and eyespot (*Cercosporella herpotrichoides*) are the most widely-occurring soil-borne diseases, although sharp eyespot (*Corticium solani*) and, to a lesser extent, brown foot rots (*Fusarium* spp.) may be a cause of loss in some areas. All affect the roots or base of the plant, causing death or poor growth with a resulting reduction in yield; all may be carried over from one crop to the next on infected debris in the soil, and, although there are differences in the manner in which they infect the plant, the measures which can be taken to reduce the risk of attack are essentially the same for all.

Take-all attacks the roots of the plant and the severity of infection and the time at which this takes place will determine the effect upon the crop. Stunted patches may occur in the spring following early infection but these are more usually seen later in the year as a result of severe attack. In many crops, however, the disease may be less obvious, a general low level of infection being reflected in poor yields and by shrivelled grain.

The fungus can survive on infected stubble for some months after harvest until the available food materials have been exhausted or the debris decomposed by soil organisms, but it cannot exist in the soil for any length of time after this and must pass on to the roots of a living plant to maintain itself. The roots of a subsequent cereal crop or of self-sown seedlings may be attacked at this stage, but carry-over from one crop to the next is achieved

most frequently on the roots of infected weed grasses. Perennial stoloniferous grasses, particularly couch (*Agropyron repens*) and bent (*Agrostis* spp.), are capable of maintaining the disease and under continuous cereal cropping, where the risk of grass weed infestation may increase year by year, these are the major source of infection.

Both wheat and barley may be attacked but oats are not affected by the strain of the fungus commonly occurring in England. A closely-related strain occurs on this crop in Wales and Scotland, however, and also in some parts of England where oats are regularly grown. No cereal varieties are resistant to take-all, although barley appears to be more tolerant to infection than wheat.

Eyespot attacks the plant just above soil level and tillers may be killed as a result of penetration early in growth. Later in the year the disease causes weakening of the base of the straw. This can result in a fracture which may show in the crop either as an indiscriminate straggling of individual tillers or as large laid areas. The fungus can survive on infected debris for a longer period than take-all and infection occurs by means of spores produced on the stubble of a previously-infected crop or on infected plants. Epidemic spread within the crop is favoured by cool, wet periods in early spring.

Eyespot is usually of most concern in winter wheat, although spring-sown crops may be attacked in some seasons. Oats and barley may also be affected and, whilst the disease has not hitherto been regarded of great significance in barley, extensive infection has recently been a feature of many crops in southern England, where spring barley is being grown continuously. Short, strong-strawed varieties are less prone to lodging. A few varieties of winter wheat are resistant to eyespot, but there are no resistant barleys.

Leaf diseases

The problem of falling yields attributable to soil-borne diseases has rightly attracted a considerable amount of attention in recent years, but the role of leaf diseases as contributors to such losses should not be ignored. Many fungi attack the leaves of cereals, and whilst many of these diseases are of little, or only local, significance, mildew (*Erysiphe graminis*), rusts (*Puccinia* spp.) and barley leaf blotch (*Rhynchosporium secalis*) can all reduce yields under intensive systems, although they are not necessarily limited to crops grown under such conditions. All these diseases reduce the leaf area available for photosynthesis and thus have a direct effect upon the vigour and growth of the plant. The greatest damage is caused when epidemic attacks occur on the upper leaves and ears at heading time, when the heaviest demands are being made for food material to fill the grain. Severe infection at this stage can result in low yields and a high proportion of tail corn.

Seasonal conditions play an important part in the epidemic occurrence of these diseases, but changes from a rotational to an intensive or continuous system in areas favourable to infection may result in an increase in the significance of a disease which may previously have been of only minor concern. The intensification of spring barley growing in the South-West, which coincided with the wide introduction of a variety susceptible to leaf blotch, has been followed by an upsurge of this disease. Conditions in 1966 were favourable to attack by rusts, and the increase in the acreage of a winter wheat variety susceptible to a new race of the disease was accompanied by a severe epidemic of yellow rust in eastern and southern England. In the same period, brown rust was widespread in spring barley.

Leaf disease may reach epidemic proportions only in favourable seasons or in limited areas. But lower levels of infection may be present every year and cause losses which can have a marked influence on the profitability of the cereal crop, particularly if other factors are also contributing to a lowering of yield. If such diseases are present in crops which are also affected by soil-borne diseases, the result could be serious. It is, therefore, equally important that every effort should be made to minimize the chances of a build-up of leaf diseases.

Resistant varieties

The ideal solution of the disease problem would be the production of suitable resistant varieties, but it is improbable that the situation will ever be reached where resistance to all the common diseases is incorporated into a range of economically acceptable varieties. The soil-borne diseases have proved particularly intractable in this respect, and there are limitations in the resistance of current varieties to leaf diseases. The use of resistant varieties should be considered where these are available, particularly in areas known to be subject to epidemic attack, and under such conditions varieties known to be susceptible should be avoided. Varietal resistance does not give an absolute guarantee of freedom from attack, and in favourable conditions infection may occur, but the severity of the attack will be less than in susceptible varieties. Resistant varieties may react differently to disease in different parts of the country and the occurrence of new races of a disease may result in the failure of a variety to live up to its original promise.

Cultural measures

Apart from the use of resistant varieties of winter wheat to avoid losses from eyespot, soil-borne diseases cannot be reduced or eliminated by choice of variety, although the use of short-strawed wheats and barleys which will not lodge following high nitrogen applications is valuable in mitigating the effects of root loss caused by take-all. The control of soil-borne disease therefore depends upon the crop being managed in such a way that the build-up of the fungi concerned is reduced to a minimum by eliminating as far as possible the sources of carry-over from one crop to the next. This calls for the management of cultivations so as to encourage the decomposition of infected crop residues, to destroy infected volunteer plants from the preceding crop (which will also remove a source of leaf diseases), and to eliminate perennial grass weeds with as long a period as possible between harvest and drilling the following cereal crop. To this must be coupled adequate fertilizer applications to maintain a high level of fertility, so that the crop can withstand the effects of any loss of root which may occur as a result of take-all. It will be appreciated that this applies particularly to spring-sown crops, where perennial grass weeds provide the principal source for the carry-over of take-all. The success of continuous cropping with spring barley in relation to soil-borne diseases is due in a large measure to the fact that this crop lends itself to the methods of cultivation desirable for disease control. Also, the period between one crop and the next is sufficiently long for these measures to take effect.

The best form of post-harvest cultivation is debatable and, since this must depend upon soil type, it is impossible to lay down any hard-and-fast rule which will be acceptable or applicable to all situations. It is important to

ensure the optimum conditions for decomposition, and in this respect stubble cultivations may have an advantage over ploughing because they incorporate the debris in the surface layers of the soil, where the organisms concerned are most likely to be active. Deep ploughing may only result in the infected material being buried at a level where rotting is slow and from which later operations may bring it to the surface as a source of infection for a newly-drilled crop.

Whether cultivating or shallow ploughing is undertaken, this should be done as soon as possible after the crop has been removed from the field, and should be followed by further treatment to eliminate both weed grasses and self-sown cereal plants. In the case of spring-sown crops where grass weed infestation is becoming a problem, the final ploughing should be delayed as late as possible. On light land, where there is an adequate depth of soil, deep ploughing at this stage has the advantage of burying both infected debris and unrotted grass weeds at a depth where they are unlikely to be disturbed by subsequent cultivations, and where the death of any living grass roots will be ensured. This ploughing must be carried out effectively because rapid re-invasion by grass weeds can occur if the furrows are not completely inverted. Whatever the system of post-harvest cultivation, spring working should be so managed as to avoid the risk of bringing infected material to the surface layer of the soil, where contact with the roots of seedling plants may lead to infection. For this reason, surface cultivations are preferable to ploughing, and they have the additional advantage that a firm seedbed can be produced which is conducive to even sowing and establishment.

Good establishment is important in mitigating the effects of disease, and this must be considered in relation to fertilizer application. One of the factors contributing to the success of continuous barley production has undoubtedly been the practice of increasing nitrogen applications year by year. The rate at which nitrogen should be applied must be considered in relation to the requirements of the crop, bearing in mind that there will be an optimum level above which an increasing response may not be obtained and at which yields, instead of increasing, may fall off because of lodging and other reasons. Excessive nitrogen applications may lead to the production of a thick, soft-strawed crop, particularly susceptible to infection by eyespot.

Intensive wheat

There is insufficient evidence to judge the practicability of continuous cropping with spring wheat, but it is reasonable to assume that, because of greater susceptibility to take-all, the disease risk would be greater than with spring barley, although eyespot would be a lesser hazard than in winter wheat. Whilst continuous winter wheat has been successful in some cases, it is doubtful if it would be practicable on most soils suitable for the crop because of the greatly increased possibility of disease; the risk of eyespot is greatest with this crop, and the short period available between harvest and drilling makes the elimination of infected stubble and grass weeds difficult. For this reason, winter wheat may best be considered in relation to systems of intensive cropping in which suitable break crops can be introduced to reduce the risk of an increase in soil-borne diseases.

Break crops

The role of one-year break crops in relation to disease in both intensive and continuous cereal growing is open to discussion. There is some evidence that

their beneficial effect in reducing take-all may only be temporary and that in subsequent crops the disease can quickly build up to a dangerous level. Because of this, their use cannot be considered in isolation and their introduction will probably be governed by factors other than disease. Where spring barley is being grown continuously without yields falling to uneconomic levels, the introduction of a break could be a disadvantage unless there was a practical reason, such as the need to control grass weeds or to improve soil structure.

Under intensive systems, where wheat may be the basic cereal, the selection of suitable break crops in relation to disease control is important. The longer the break the greater are the prospects of a reduction in the disease risk; where take-all is the problem one year under a suitable alternative crop may be adequate, but where eyespot has reached a serious level a minimum of two years is essential. The length of the break and the choice of crop will probably be influenced by economic considerations, the available labour and machinery and the presence or absence of livestock, although in some cases it may be good policy to accept a choice with a low return if this has been shown to offer a high degree of disease control.

Since the choice of a break crop may be governed by a number of considerations, it is impossible to specify a 'best buy' which would meet every requirement. Ryegrass leys are satisfactory, provided they are not infested with weed grasses, though, when undersown in cereals, they can be a source of disease where shed corn remains to carry soil-borne and leaf diseases. They may, however, not be practicable in intensive systems because of the difficulty in stocking and grass for herbage seed production may be a suitable alternative with many of the advantages of a ley. Under some circumstances, spring-sown cereal crops may provide an adequate break in short runs of winter wheat; because they are not attacked by take-all, oats would be an attractive alternative cereal were it not for the risk of cereal root eelworm on some soils. As crops other than cereals are unaffected by take-all and eyespot, the choice is wide provided the selected crop is such that grass weeds and volunteer cereals can be eliminated during the period of the breaks. Ultimately, the final decision will probably have to be made on the basis of the practicability of handling the alternative crop. With the available machinery and labour, and in suitable areas, beans and oil seed rape may be worth consideration.

Good husbandry the key to control

Diseases may limit the profitability of the cereal crop, and it is important that the risks involved should be appreciated. The measures to be taken to prevent their build-up cannot, however, be considered in isolation. Choice of variety and of suitable alternative break crops may be governed by advantages other than their role in disease control, and soil and seasonal conditions will play a decisive part in limiting the practical measures which can be undertaken. Good husbandry and attention to detail are of the utmost importance in intensive systems in ensuring that the crop is grown under optimum conditions in which it is exposed to the least risk and where the effects of infection are reduced to the minimum.

This article has been contributed by **Alan G. Walker, B.Sc., Ph.D.,** who is Regional Plant Pathologist in the South-West Region of the National Agricultural Advisory Service and is stationed at Bristol.

Barn Dried Hay

M. V. Jackson

BARN hay drying started to make an impact in this country immediately after the war, in 1945, when the process of 'mow drying' was imported from the U.S.A. However, like so many 'new' ideas in farming it had been tried here long before that, the first reference in the literature being in the Journal of the Royal Agricultural Society in 1869. The pre-war efforts were mainly isolated cases on a small scale, and it was not until after the war that the process became widespread to any extent in this country.

In the decade preceding 1956 virtually all barn dried hay in the U.K. was dried loose and until 1954 almost entirely with unheated air. However, the British climate being what it is, the need for heat to increase the moisture-carrying capacity of the ventilating air soon became obvious. In addition, the meticulous care and hard work needed in loading the bay with loose hay, the increasing shortage of labour and the increasing use of the pick-up baler all combined to make drying in the bale a much more attractive proposition. At first, drying in the bale was mostly carried out on the batch principle but the double handling entailed with this method made people turn increasingly to storage drying.

Present day techniques

At the present day most barn hay drying is done with baled hay on the storage system. That is, the hay is brought into the barn in which it is to be stored for the winter, it is dried there and then left. Because of the limitation in the amount of hay that can be dried by one fan unit the bales are dried a few layers at a time. When one bay is full the fan unit itself is moved to the next bay, or in a duct system flaps are moved to divert the air from a fixed unit.

In this article it is not proposed to dwell at length upon the practical techniques of barn hay drying. Suffice it to say that, as in any successful operation, attention to detail is of paramount importance. Uniform drying of the swath in the field is vital. Bales should be of medium density and should

be packed carefully in the drying bay, with alternate courses running at right angles. Insufficient care at either the field stage or in loading the bay can result in mouldy bales.

It is important to have a fan unit big enough to cope with the job. Also, the results of work at Drayton E.H.F. suggest that some means of heating the air is very desirable. Blowing cold air throughout is attractive from the point of view of capital cost and, of course, is widely practised on farms. It is also cheaper in running costs to blow cold air than to heat that air as well. However, in conditions of high atmospheric humidity it can be cheaper to use warmed air because drying proceeds more rapidly. Such are the findings at Drayton, using an oil-fired heat exchanger for drying hay fairly early in the year. At a relative humidity of 70 it cost the same to remove 1 cwt of water from the hay using cold air or heated air. At an R.H. of 90 it cost five times as much to use the cold air because drying took so much longer. Taking 1964 as an example, from 15th May to 30th June, the R.H. only fell below 70 on ten days and on seventeen days it was 80 or more. A great many other factors are involved but the use of heat at Drayton was generally economic.

Feeding value

There is no doubt that for growing and fattening beef cattle, barn dried hay fed alone or with a small quantity of concentrate (2½–3 lb) has given consistently better results than field made hay or wilted silage cut from the same field. This conclusion has been reached after a number of years' trials at Drayton. The results from feeding barn dried hay are not only better in physical terms but, more important, in financial terms as well. Where, however, more concentrate (6–7 lb or more) was fed then it mattered little whether the roughage was silage or hay.

A great deal of work has been done at Bridget's and Great House Experimental Husbandry Farms on barn hay/pit silage comparisons using dairy cows. At Bridget's the cost of production of the two fodders, at the cow's mouth, was very similar. Higher labour, machinery and fuel costs, coupled with lower dry matter losses for the hay, were balanced by lower labour and machinery costs, but greater losses for the silage. When both fodders were offered *ad lib.* the cows on barn dried hay ate more dry matter than those on silage and put on weight as a result of luxury consumption of the hay. The cost of concentrate for these cows was lower than for the cows on silage, for slightly greater milk yields. However, due to the luxury consumption of hay the margin from milk on a gallonage basis was slightly higher with silage feeding. Cows on silage lost appreciable amounts of body weight, depending on level of concentrate feeding.

Space does not permit expansion of these results but work at Drayton, Bridget's and other Experimental Husbandry Farms has shown that barn dried hay is a first class feed for ruminants. When conventional field dried hay is made from young grass and is got quickly without being affected by rain it is equally good, but how often is this desirable set of conditions achieved? One year in five is a reasonable guess.

Difficulties to overcome

While there is no doubt about the reduction of nutrient loss, and the quality and the feeding value of barn dried hay (provided that it is well made

from young grass at the pre-flowering or early-flowering stage), there are a number of problems about it which cannot be glossed over. The most important of these is that it is very much more difficult to make, say, 100 tons of barn dried hay in a season than it is to make 300 tons of silage, which contains a roughly equivalent amount of dry matter. This is because silage making is easier to manage than barn hay drying, labour management is less complex, there are fewer managerial decisions and fewer technical difficulties. If one assumes a herbage yield of two tons of dry matter per acre (a single cut in the second half of May) the produce of the 55 acres or so can be ensiled over a very short period—from a few days to a couple of weeks depending on the scale of the operation. During this period most of the grass can be got at or very near its optimum stage of growth. With barn dried hay, however, assuming that 20 tons could be dried at once in the barn, and that this took at least 3–4 days and often more, then it would take a *minimum* of 18–24 days. During this time much of the grass would have passed its peak of nutritive value unless cutting began with a crop of very uneconomic yield. Also this minimum period assumes that the weather is always good at the time when the grass is lying and being worked in the field. In practice it is seldom so kind.

How are the problems to be overcome? It has been suggested that to provide grass at the optimum stage of growth for top quality hay a succession of crops can be arranged, using different species, varieties, grazing beforehand, etc. The majority of farmers have limited capital resources and with probably a single fan unit they can only afford to dry limited quantities at any one time. For such farmers it is hardly economic to grow a succession of 10-acre (or smaller) patches of this, that and the other grass or legume crop. This method therefore suggests itself more to the man who operates on a larger scale or to a consortium of farmers sharing the capital cost.

Handling

Irrespective of the size of the enterprise there is always the problem of handling heavy bales of partly dried hay quickly, especially when bad weather threatens. For the smaller family farmer with a wife and sons labour may not be short, but it is hard work. There are, of course, numerous mechanical aids to bale handling available but many of them are expensive.

Once on a trailer the hay is relatively safe. A sheet can be thrown over it as a temporary measure to protect it from the weather. The trailer must be unloaded and the drying bay filled and there are mechanical aids to help accomplish this. One of the most useful of these is a horizontal conveyor which can be suspended from the roof of the barn and raised with blocks and tackle as filling proceeds.

One development, which received some publicity two or three years ago, is the drying of chopped loose hay. Coupled with suitable self-feed or easy feed arrangements it eliminates most of the manual work connected with bales, to say nothing of eliminating the bale itself. The greatest drawback to the method is that of uniform filling of the drying bay. It is understood that the method is being examined at the National Institute of Agricultural Engineering, where much emphasis is put on material which 'flows'. The possibilities of wafering have been considered but there are certain practical difficulties.

Talk of eliminating the bale raises the question of the best size and kind of package to dry. The N.I.A.E. are looking at giant bales, each of which could

be handled as a separate unit. There is a strong feeling that the normal bale as we know it now is too small for good mechanical handling and that it will ultimately disappear.

What of the Dutch method of barn drying? In this system cold air is blown down through a vertical duct left in the centre of a stack of hay by building it round a former or 'bung'. This bung is drawn upwards as filling proceeds. The air moves radially out through the stack from the central duct. A good deal has been written about this in recent months. Its greatest virtues seem to be the relative cheapness of installation and its flexibility, but it does nothing to overcome handling problems and the lack of a means of heating the air may restrict its usefulness.

Advantages and disadvantages

Barn hay drying has its problems. As a conservation method it accounts for a relatively small proportion of the total fodder conserved in the country but it appears to be increasing in popularity in the north-west of England. Here, it is the smaller farmers who are making it. Many of them have shippons which are too inconvenient for silage feeding. The need for close attention to detail probably makes barn drying more suited to the small family farm. It is a prolonged job and one which suits a small dairy farmer with spare time in the middle of the day, whereas silage-making has an intensive labour peak during May or June. It does enable farmers in the wet parts of the country to make at least some good hay every year. It could be argued, of course, that they should be making silage. However, many farmers in such circumstances either cannot or simply do not wish to make silage, especially next to the house.

Finally, with the considerable increase in number of farmers possessing on-the-floor grain drying and storage facilities there is possibly scope for some barn hay drying as a sideline. During the late spring and early summer, when labour is slack on a cereal farm, the grain drying equipment is idle. Many cereal farmers already have pick-up balers for dealing with straw and they will also have some sort of trailer or trailers. Therefore, little extra equipment may be needed. Since numbers of cereal growers are finding it necessary to re-introduce grass as a break crop and yet do not want to keep livestock, then one way of utilizing their grass break would be to make it into top quality hay for sale, perhaps taken from two cuts before corn harvest. Among potential buyers might be farmers in the wetter parts of the country, some of whom would be better off carrying more livestock and buying in their winter fodder, without struggling to make hay.

M. V. Jackson, B.Sc.(Agric.), has recently taken up an appointment as a N.A.A.S. liaison officer at the Grassland Research Institute. Before taking up this appointment he was Deputy Farm Director at Drayton Experimental Husbandry Farm for five years.

Long Ashton Reports

Sylvia Laverton

LONG Ashton Research Station reports[1] that in collaboration with East Malling Research Station further progress has been made towards wider use of virus-tested fruit trees. Seven more apple varieties free from known viruses were made available, bringing the total number of dessert and culinary varieties released to the industry up to twenty. Work with cider apples as well as dessert and perry pears continues: seven virus-free clones have been produced.

Trial orchards

The number of trial orchards established to study the long-term effects of latent virus infection on growth and cropping has been increased from three to eight by new experimental plantings, comprising three of dessert and two of cider apples at the Essex Institute of Agriculture, Writtle; Pershore Horticultural Institute; the Horticultural Research Centre, Loughgall, N. Ireland; Rosemaund Experimental Husbandry Farm, Hereford; and Messrs. Bulmer's Orchard, King's Acre, Hereford. The first trial orchards were planted in 1964 at Long Ashton, the Luddington Experimental Horticulture Station and the Somerset Farm Institute, Cannington.

Apple viruses

The information accumulated to date from observations comparing the growth of heat-treated and virus-infected trees indicates that commercial apple varieties differ considerably in their reaction to the latent viruses causing epinasty and decline, chlorotic leaf spot and stem pitting. Fourteen out of the nineteen varieties tested on M.26 rootstock showed some increase in vigour in the maiden year when free from infection with this group of commonly-occurring viruses; four were more vigorous when infected.

The first year's growth of heat-treated trees of Cox's Orange Pippin on MM.111 was more uniform and the trees were taller than virus-infected trees produced from the same clones. The virus causing epinasty and decline is more heat tolerant than the other two viruses under examination in this series of experiments, so that after heat treatment several clones remained infected with this virus only. It has therefore been possible to study its

[1]Annual Report of the Long Ashton Research Station, 1965. 20*s*.

influence by comparing the growth of these infected clones with uninfected ones, using four varieties of apple on seedling crab rootstock. After four years, the infected trees appeared relatively unaffected by this virus alone. Heat treatment may, however, have attenuated the virus and differences may become apparent later. In another experiment, virus-free scion material from the original Bramley's Seedling was compared with a clone carrying all three latent viruses in trees grown on MM.106 and on MM.111. So far, this variety seems to be relatively tolerant to these viruses—no significant reduction of vigour was recorded in the four-year-old trees. Some effects may appear when the trees come into bearing.

Pear viruses

Many dessert pears are wholly infected by a number of viruses, some of which can affect the young trees' growth. Virus diseases are also frequent in perry pears. These are sometimes so widespread that no healthy trees can be found. Encouraging progress is being made at Long Ashton in the elimination of pear viruses. Heat treatment at 38°C for periods ranging from 23 to 57 days, followed by tip propagation, has proved very successful with five dessert and ten perry pear varieties, failing in only one instance to eliminate all the viruses known to be present. It would seem that 23 days' heat treatment is sufficient to eliminate all the common pear viruses. For most of the varieties used, trees grown from heat-treated material grew more vigorously than untreated trees during the first two years. Further work will be necessary to examine the performance of heat-treated and virus-infected clones over a longer period, but if cropping and growth prove satisfactory, the material available from heat-treated clones will be multiplied and distributed.

Cider apples

As the culmination of 10 years' work, during which a very large mass of data has been assembled recording the external and internal anatomy of cider apples, a new system for the identification of 73 different varieties of cider apples has also been prepared. Full details, with illustrations, are given in the Report. Though many other varieties are grown to a limited extent, the scheme is confined to those recommended by Long Ashton or by cider makers during the past 50 years. These varieties constitute the bulk of existing orchards. Only a few are, in fact, recommended for present-day planting.

Problems associated with the decline in acreage of cider orchards have been under consideration by Long Ashton for some years and in 1964 investigations, in collaboration with the industry, were begun into the possibility of improving the profitability of future orchards by technological changes. The conclusions, given in some detail in the Report, confirm that, if the decline continues as at present, a very considerable reduction in cider fruit supplies is likely within a decade. It is suggested that existing mature orchards, designed and developed along recommended lines, can produce profitable returns that compare favourably with most farm enterprises, but many old orchards cannot be economically viable without unrealistically high fruit prices. Despite the drop in acreage, the retention of these old orchards should not be encouraged.

The main disincentive to new planting, highlighted by economic analysis, is the long establishment period during which interest charges must be met, and the land is not available for growing crops with a rapid financial turnover. Methods of combating this difficulty that have been proposed include intercropping during the early years, the use of modern varieties that come into bearing quickly, closer planting, and efficient application of modern management techniques. Since increasing quantities of dessert apples are expected to be available for cider making in future, new cider orchards should be planted with bittersweet varieties, more particularly the medium and heavy tannin types, for blending with the low-acid dessert varieties to maintain the character of English cider. In future, a high proportion of the vintage quality bittersweets may have to be grown in the cider makers' own orchards.

Pollination

Changes in fruit culture have focused attention on pollination. Mixed orchards are rarely planted now and the number of apple and pear varieties grown is steadily being reduced. In addition, the trend towards smaller trees and hedgerow plantings, which produce different canopies, may markedly influence the orchard micro-climate. These factors, and other changes in fruit cultivation, may have a significant effect on insect populations in orchards. Five aspects of present-day pollination requirements are now being studied at Long Ashton. The aims are to re-assess the importance of various insects present in orchards; to follow up recent suggestions that wind may be an important agent for cross pollination; to check the effective distance for a pollinator variety; to produce some measure of the effective pollination period of flowers of commercial varieties and to assess the relative importance of cross pollination in setting an economic fruit crop.

Observations at East Malling that large quantities of airborne pollen may be present in orchards at blossom time were confirmed at Long Ashton, but further work is needed to determine the value of wind in transporting pollen from flower to flower. Preliminary observations with apples and pears indicate that varieties may vary a lot in the effective pollination period, and in addition there may be large variations from year to year in many apple varieties. These large differences occurring between and within varieties may help to explain the reason for some fruit set phenomena, for instance why Comice can be such a shy cropper. Methods of lengthening the effective pollination period of shy-cropping varieties are being investigated. They include acceleration of pollen tube growth and extension of ovule longevity.

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Disposal of Farm Effluent

Animal Health

E. A. Gibson
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IS THE slurry system a danger to animal health? Some of its opponents claim that it is: some of its advocates seem to ignore the question. My own view is an intermediate one, namely that a degree of hazard may be present under certain circumstances but that it is most important to keep a sense of proportion on the subject. One of the chief aims of this article will therefore be to discuss these various hazards and to try to put them into perspective.

Infectious diseases

The hazards involved are of various kinds. Quite understandably, however, most emphasis to date has been put on the risk of infectious disease. It is, after all, well known that various infections of our domestic animals and birds are spread in their excreta. This is obviously true for intestinal diseases, such as *E. coli* infections of piglets, salmonella infections of calves, Johnes disease, coccidiosis and infestations of intestinal worms. It is also true for lung worms, liver fluke, some cases of tuberculosis, and for a number of virus infections. It is common knowledge that these and other infections can spread through a herd or flock under normal conventional conditions of husbandry and grazing, and when traditional methods of muck disposal are used. This, of course, is why it is always recommended that manure from sick livestock should be disposed of on arable land, well away from pasture. Obviously then, when we come to consider a technique, such as the slurry system, in which the faeces and urine of livestock—possibly including some diseased individuals or some carriers of disease organisms—may be spread on to pasture or fodder crops, we need to ask whether this is likely to increase the hazard of infection. Fortunately, it seems that under British conditions there are remarkably few diseases of which this can be said.

Looking at the problem in general terms, the hazard of infection is likely to increase if livestock encounter disease organisms that they would not encounter under traditional systems, or if they encounter them in significantly greater numbers. There are possibly three ways in which use of the slurry system might cause this to happen. Firstly, its use may lead to the disposal on to pasture or fodder crops of infective material that would normally go elsewhere. In this way, the excreta from a house of purchased calves, in which salmonella infection is quite likely to be present, might be spread on to pasture in a comparatively fresh state instead of being held in the bedding,

and then perhaps in a muck heap, for several months before being spread on to arable land. Other things being equal, the slurry system could in this way give rise to an additional and significant hazard. Similar considerations might sometimes apply to the spreading of slurry from beef units or dairy herds, or from poultry. The second point is that the spreading of slurry prevents cattle and sheep from following the pattern of selective grazing by which they normally avoid herbage that has been soiled with the faeces of their own species. It has been suggested that under some circumstances soiled areas may be avoided for as long as twelve or eighteen months. This form of protective selection is obviously impossible if the whole pasture has been sprayed with slurry. Again it seems that, other things being equal, the grazing animals will thus come into contact with a larger number of organisms than before. Thirdly, the introduction and spreading of slurry from other premises—for example from intensive units with little or no land of their own—may introduce infections that were previously absent, as may the drifting of spray from the tankers or irrigation pipelines of neighbouring farms.

Survival of disease organisms

This, however, is only the general framework within which the hazard of infection might be increased. Thus before it could take advantage of these circumstances a disease organism would have to survive the period of storage in the slurry tank and the various chemical and biological changes that may occur there, and then, after spreading, survive for long enough and in sufficient numbers on the herbage or fodder crop to be still viable and infective when contact was finally made with the animal host. Fortunately, there are only three important infections that meet these criteria and which have the other attributes necessary to produce a significantly increased disease hazard when the organisms are spread in this way. They are salmonella infection, Johnes disease and anthrax.

As far as I know, no one has yet studied the survival of these organisms in slurry tanks or on herbage sprayed with slurry, but it is well known that all three can remain viable and infective for considerable periods under practical farm conditions associated with conventional systems of disposal. The length of the survival period can vary greatly because it is influenced by temperature, humidity and acidity, by exposure to sunlight, by the presence of other organisms, and by various other characteristics of the environment. However, as a working guide it can be said that under favourable practical farm conditions salmonella organisms may survive for some six or twelve months. Similarly, Johnes organisms may survive for twelve months or more on moist shaded pasture. More recently it has been reported that Johnes bacilli are unlikely to survive for more than a week in bovine urine, or for a month in a 1 : 9 mixture of bovine faeces and urine, and this suggests that their survival in a slurry tank may also be limited to a few weeks. Anthrax organisms, however, are very much more resistant. Their spores commonly survive for ten to twenty years or, in some favourable circumstances, for very much longer.

Until contrary evidence is produced we should assume that all three kinds of infection could survive the slurry process and remain capable of causing disease. They therefore warrant more detailed discussion. The organism of avian tuberculosis is also a resistant one, and although this infection is most unlikely to constitute a major hazard it, too, warrants further discussion.

Salmonella infection

It is difficult to generalize about this because there are about a thousand different types of salmonella organisms. However, the picture is simplified by the fact that only a few of these are of every-day importance in our domestic livestock. Some tend to be limited to a single host. Thus, *Salmonella cholerae suis* is rarely found in livestock other than pigs. Others may have several hosts. Thus *S. dublin* occurs chiefly in cattle, but can also be of importance in sheep. Others, of which *S. typhimurium* is the prime example, can infect practically all species of animals and birds with equal facility. *S. typhimurium* is also of importance as one of the chief causes of food poisoning in man.

As was described in a recent issue of this journal (E. A. Gibson, *Agriculture*, May, 1966, pp. 213-216) nearly all salmonella infections in cattle involve either *S. dublin* or *S. typhimurium*. Both these organisms are found commonly in calves, and especially in intensive units stocked with market calves. Most affected calves show diarrhoea, but the disease picture is somewhat variable, and pneumonia or arthritis may also be present. Some calves may die suddenly, before other signs of disease have been noticed. *S. dublin* and *S. typhimurium* can also affect adult cattle and yearlings, usually causing an acute diarrhoea in which the faeces commonly contain blood, mucus and shreds of bowel lining. Many die within a few days. Cases involving *S. typhimurium* are comparatively rare, but there are certain areas in England and Wales in which *S. dublin* is well known as the cause of sporadic illness or death in adults and yearlings. Cattle that recover invariably continue to excrete *S. dublin* in their faeces for several years if not for life. Other cattle, with no history of this kind of illness, may also be found to be constantly passing large numbers of the organism in their faeces, and it will be seen that either kind of 'carrier' could give rise to a contaminated effluent.

Both *S. dublin* and *S. typhimurium* can also cause serious losses in sheep. *S. dublin* is not uncommon as the cause of outbreaks of abortion in which many of the aborting ewes may die from septicaemia. *S. typhimurium* has also been known to cause heavy mortality in ewes and younger lambs characterized by enteritis, septicaemia and abortion.

Effluent from pigs does not usually contain important numbers of salmonella organisms. However, outbreaks involving various salmonella types, especially *S. cholerae suis* and *S. typhimurium*, occur in pigs from time to time. Similarly, infection is uncommon in adult fowls and turkeys. It occasionally occurs in young chicks and poults, but is now less common than previously. Young ducklings, however, are very commonly infected with salmonellae, especially *S. typhimurium* and *S. enteritidis*, both of which can cause disease in other species. These remarks are briefly summarized in Tables 1 and 2.

Table 1

Types of salmonella likely to be present in effluent from livestock

Adult cattle Home bred calves	*S. dublin*—but only in certain areas.	
Purchased calves	*S. dublin* *S. typhimurium*	
Pigs	*S. cholerae suis* *S. typhimurium*	but neither is common
Chicks and turkey poults	various types (including *S. typhimurium*) may occur, but nowadays none is common	
Ducklings	*S. typhimurium* *S. enteritidis*	both are commonly present

Table 2

The host species most likely to be adversely affected by contact with contamination with various types of salmonellae

S. cholerae suis	pigs
S. dublin	cattle, sheep (abortion)
S. enteritidis	cattle (? sheep)
S. typhimurium	cattle, sheep, man

It follows from this that if there is reason for suspecting that salmonella infection has occurred in calves, older cattle, pigs or poultry, it is generally undesirable to spread the excreta, either as manure or as slurry, on to pasture or fodder crops that will be used by cattle or sheep in the near future. In the present state of our knowledge it is difficult to specify how long an interval should elapse between spreading and grazing, but it seems that there should be little or no risk by the end of six months. It may, however, be necessary to revise this estimate as more experience and knowledge is gained.

As far as salmonella infection is concerned it is suggested that these precautions should be applied only when it is known or suspected that infection is present. Moreover, the situation on each farm should be assessed individually on its own history, although, as previously indicated, the effluent from a duck-rearing unit would usually be suspect, as, to a lesser extent, would that from a unit of purchased calves.

Avian tuberculosis

It was mentioned above that salmonella infection is uncommon in adult fowls and turkeys. This may suggest that slurry from battery hens could be spread on pasture without risk to cattle, but unfortunately another factor, namely the possible presence of avian tuberculosis, arises here. Cattle that have experienced this infection rarely show any clinical illness, but the infection tends to complicate the interpretation of the tuberculin test and is, therefore, best avoided. It does cause localized infection in the head lymph nodes of pigs, leading to the condemnation of the head at meat inspection. Avian tuberculosis is rare in battery birds in eastern England, where most pullets are now reared intensively, but is not uncommon in the west of England where replacement birds are still commonly reared out of doors and so are more likely to become infected with avian tuberculosis derived from wild birds. Again, it will be seen that advice is best based on the history of the individual farm rather than on some general rule.

Johnes disease

Johnes disease occurs in cattle throughout Britain. In contrast to the acute dysentery that is characteristic of salmonella infection, it causes a chronic diarrhoea. This is invariably fatal. The incubation period is remarkably long. Cattle are most easily infected during the first six months of life, but although most cases of Johnes disease are due to infection acquired during this period, clinical signs of disease are seldom seen in animals less than two or three years old. Sheep are also susceptible, and show a marked loss of condition with or without diarrhoea.

It is known that, as with many other diseases, far more cattle acquire the infection and carry it in their tissues—in this case the intestines and associated lymph glands—than ever develop clinical signs of it. Fortunately the disease organism is rarely present in the excreta of animals in which the disease has not progressed to the extent of causing diarrhoea. However, when diarrhoea

does develop the animal becomes a hazard to the rest of the herd—and especially to young calves and to stock under six months of age—and should, therefore, be kept in strict isolation.

It follows from what has been said about the survival of Johnes bacilli that the excreta from a herd in which the disease is present should not be spread, either as muck or as slurry, on to grass or other fodder crops that will be used later by cattle or sheep, and that contamination of pastures or crops intended for calves should be especially avoided. Again, it is difficult to specify how long an interval should elapse, but it has been suggested that the hazard to adult stock should be reduced to an acceptable level by the end of six months. For calves and young stock, however, an interval of twelve months is preferable. As was indicated above, further work on the survival of Johnes bacilli in slurry may make it possible to reduce these figures.

Anthrax

Anthrax is well known as a cause of sudden death or acute illness in cattle, and of a somewhat more prolonged illness in pigs. Sheep are also susceptible, but are rarely affected under British conditions.

The disease is not rare in Britain but, fortunately, is much less common than either salmonella infection or Johnes disease. It is, of course, one of our scheduled notifiable diseases, and any suspicion of its presence should therefore be reported to the police who are then responsible for the safe disposal of any carcasses, excreta and other contaminated materials.

One of the outstanding characteristics of the anthrax bacillus is that although the 'vegetative form' in which it occurs in the animal body is readily susceptible to disinfectants and the effect of putrefaction, exposure to air results in the formation of highly-resistant spores which, as mentioned previously, may survive for many years. This is why it is extremely important that any contaminated materials should be disposed of only by the methods specified by the Anthrax Order and should not be put on to either arable or pasture land.

Other infections

Infections with parasitic worms are unlikely to be more troublesome under the slurry system than under conventional systems of manure disposal. This is partly because the methods of storing and spreading slurry do not favour these organisms, and partly because the slurry system tends to be used in conjunction with intensive methods of husbandry under which many parasitic infestations are unable to establish themselves.

Less is known about the possible survival of virus infections. Some of these, notably foot-and-mouth disease and Newcastle disease (fowl pest) are scheduled notifiable diseases, with the result that, as in the case of anthrax, the safe disposal of effluent and of any other contaminated material becomes the responsibility of the officials in charge of the outbreak. It seems likely that some other virus infections, such as transmissible gastro-enteritis ('TGE') of pigs, could be spread by airborne droplets from slurry disposal systems. However, quite apart from the scientific aspects of the matter, an owner with an infected herd would obviously be ill-advised to dispose of effluent in a way that courted criticism from neighbouring stock-owners. Indeed, I would suggest that, as a general principle, owners with any problem of infectious disease in their stock should refrain from spreading slurry, either by irrigation pipeline or by tanker, until they have been assured by their veterinary adviser that this would not produce a disease hazard.

Other hazards

Although the possible spread of infectious disease is the hazard which causes most concern, there are other potential dangers that also deserve a brief mention. One that has received a certain amount of publicity recently relates to the release of toxic gases, notably hydrogen sulphide and ammonia, when slurry tanks are emptied or agitated. Several incidents of mortality in pigs have been attributed to this cause, as have a few in cattle. In these incidents it has been noteworthy that the slurry tank has been either full to capacity, or nearly so, at the time of emptying or agitation, and that the building has been poorly ventilated. Incidents of this kind can be avoided by ensuring that a space of 12–18 inches is always left between the surface of the slurry and the slats or tank cover, by fitting a non-return valve between the building and any outside tank, and by well ventilating the building whenever tanks are agitated or emptied. It should be remembered that these gases are also toxic to man.

Finally, it should be mentioned that slurry is rich in potassium and that applications of it may therefore aggravate the tendency of certain pastures to cause hypomagnesaemia in cattle. This problem has been reported from Holland. Elsewhere, losses in sheep have been attributed to a high nitrate content in herbage following the use of poultry slurry. Hazards have also been described from the excreta of cattle treated with oestrogens and of pigs fed high levels of copper. Sheep are especially susceptible to copper poisoning and it would be unwise to use this kind of pig slurry on pasture or crops intended for sheep.

Summary

It is well known that many infections of farm livestock are spread in their excreta. Little is yet known about the effect of slurry systems on such spread, but it seems possible that, under certain circumstances, the use of these systems could increase the disease hazard. Salmonella infection and Johnes disease are discussed in this respect, and anthrax and avian tuberculosis are mentioned more briefly. It is suggested that effluents thought to contain salmonellae should not be put on to pasture or fodder crops that will be used for cattle or sheep within six months. The same precaution applies to Johnes disease, except that for cattle up to six months old the period should be extended to twelve months. These figures may need to be revised as further knowledge and experience is gained. The non-infectious hazards to animal health include the liberation of toxic gases when slurry is agitated or emptied.

The author of this article, **E. A. Gibson, Ph.D., B.Sc. (Vet.), M.R.C.V.S.**, is the Veterinary Investigation Officer in charge of the Ministry's Veterinary Investigation Centre at Norwich.

This is the second article in the series on farm effluent. Future articles are planned to cover public health, agricultural value, buildings, machinery, dairy husbandry, pigs and poultry.

Co-operation in practice

East Riding Farm Produce Limited

R. S. Marshall

THE establishment of East Riding Farm Produce Limited was an important development for growers of potatoes and other crops. The idea of forming a co-operative venture of this kind started in the spring of 1958, when the Potatoes, Carrots and Sugar Beet County Committee of the East Riding Branch of the National Farmers' Union had before it a complaint from some branches that whilst carrots were having to be sold at a ridiculously low price on the farms, those carrots were still priced highly in the shops. Further, in the opinion of some members, the treatment and presentation of the carrots had detracted from their value and the samples which were displayed were unattractive, with the result that demand was small and sales not sufficient to clear the crop. Always forward-thinking, members of the County Committee suggested that now was the time for the National Farmers' Union to do something to remedy this state of affairs, and the idea of an organization to pack and improve the marketing of potatoes and carrots was born.

An idea develops

The suggestion was placed before the County Co-operation Committee which, in turn, and with the approval of the Executive Committee, appointed a sub-committee to look into the possibilities and report back to the Executive. The sub-committee started work immediately and, after a very thorough investigation, in the course of which they attended marketing conferences and exhibitions and travelled to various parts of the country seeking the information required, they reported back to the parent committee. The sub-committees were then given a mandate by the N.F.U. Executive Committee to set up a trading organization for the development of the ideas which they had in mind. The problem of buying or leasing a site proved to be a difficult one. Eventually the present site at Melbourne was selected because it had the advantage of easy access and water and power were readily available. Perhaps most important of all, it had the additional advantage that a large proportion of the produce likely to be handled would, for whatever part of the country it was bound, pass very close to the site, thereby avoiding any unnecessary and expensive transport costs. At this time meetings were held to which farmers in the area were invited. Much valuable assistance was forthcoming from various organizations such as the Agricultural Central Co-operative Association (as it then was), the Potato Marketing Board and the Produce Packaging Association. Capital was

subscribed by members at the rate of £100 for a member wishing to market carrots through the organization, irrespective of acreage, and at £10 per acre based on each grower's basic Potato Marketing Board acreage, with a minimum of £100 and a maximum of £500. The latter figure was the maximum shareholding allowed by law at that time for a company registered under the Industrial and Provident Societies Acts, but this has since been increased to allow £1,000 to be invested.

Trading begins

The trading activities of the company started on 1st January, 1962, by which time it was a properly constituted limited company registered under the Industrial and Provident Societies Acts, and the task of converting the idea into fact began. The first job was to press on with all speed to complete the erection of the packhouse and install washing, grading and packing machinery. The next jobs were to convert the building which was destined to be an office, obtain a nucleus of a labour force (most of whom are still with us), make contact with local hauliers (who still haul for us), meet as many members as possible (only 26 in those days) and get some idea of the samples available to work with. By the middle of the month we were in business and the first loads of ware and prepacks were in the markets.

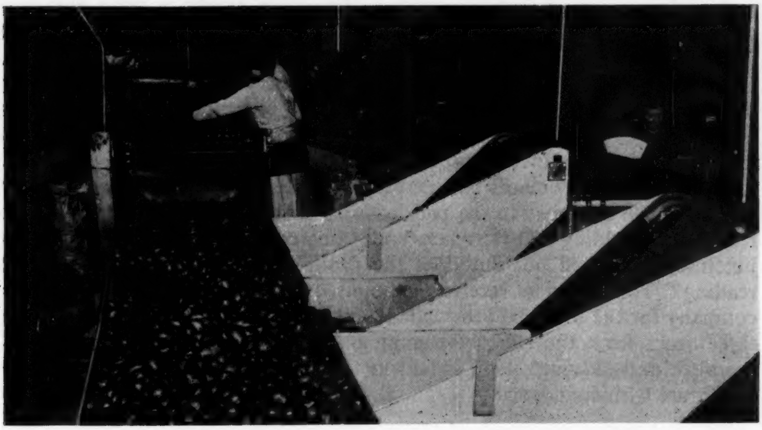
THE AUTHOR

A member of the National Association of Seed Potato Merchants, **R. S. Marshall,** who has contributed this article, is General Manager of East Riding Farm Produce Ltd.

The next steps

Those early days were full of problems and their challenge was always exhilarating, but excellent support from all concerned enabled us to weather this extremely difficult and crucial stage and to get away to a flying start. The broad plan at this time was to keep the whole company as flexible as possible, so that any available marketing advantage could be exploited to the full, as indeed is still the case. At the same time we had to establish our brand in as wide a range of markets as possible. This proved to be the correct course and was, by and large, successful. It was very quickly obvious that to make full use of the line of expensive washing and prepacking equipment it was necessary to operate mechanical handling methods, and a fork lift and pallets were purchased. All loads are now handled in this way, either being loaded on pallets at time of collection from the farm or upon receipt

at Melbourne. Thereafter they are handled in one- to two-ton units, and the finished produce is dealt with in a similar way. The next step was to broaden the scope of the company by extending the range of packs, sizes, weight units and types, thereby enabling us to seek and obtain additional outlets. As time went by and progress was made, it was very interesting to note the increasing confidence of members in the company and the increasing number of new members taking shares in it.



Red King variety coming off the washer

Formulating policy

Throughput built up quite rapidly to the point where additional working and storage space was essential and we erected another building, giving an additional 3,500 square feet. Our own transport became almost essential to obtain a fairly tight schedule of loads to the packhouse so two lorries were added to the strength and used mainly for local work. The long distance market work was left with the hauliers. The board of nine directors meets monthly to discuss in some detail various aspects of the company, and in particular to formulate policy. Undoubtedly one of the major forward steps was the decision to install and operate a central dressing plant at Melbourne so that members' potatoes could be loaded 'as grown' in bulk from the farm. They could then be sized, dry brushed or washed, and graded by skilled staff working with modern and efficient machinery, in good light and comfortable conditions conducive to a first-class end product. This not only provides a worthwhile service to members who have difficulty in dressing on the farm, but also gives the company a considerable marketing advantage, as we can now supply our customers consistently with a high-grade sample. The effect of this on our trade can be clearly seen. The decision also made it necessary to erect a further bay to our packhouse which doubled the size of the building, the first bay being constructed in a manner which allowed the wall along one side to be removed and re-erected as the side of the new bay. In view of the experimental nature, an A.M.D.E.C. grant has been approved on some of the costs of the central grading scheme as it is thought that it may have useful applications in other areas, if proved

satisfactory. After many trials to find the best method of transporting the potatoes from farm to packhouse, we are experimenting with half-ton box stillages. Whilst we still have some way to go, this method is shaping up very well for our particular purpose.

Results

Throughput for the last season was about 10,000 tons and the graph continues in an upward direction for the current season. The range of produce and packs now marketed is extensive. The main weight is ware potatoes which are sold in 1 cwt, 56 lb, 28 lb, 14 lb, 7 lb, 5 lb and 3 lb packs in several varieties. They are farm dressed or centrally dressed, dry brushed or washed, and some even peeled ready for the pot. Carrots are marketed washed or dirty in 28 lb and 56 lb nets. In the case of seed potatoes, a stock seed certificate is obtainable on the Yorkshire Wolds where some of our members farm. Crops handled include cabbage, swedes, red beet, lettuce and tomatoes.

The number of members has increased over the period and there are now 60 in all. The third bay to the packhouse is on order and when erected will result in a building 120 ft square under one roof. A fair comment at this juncture could well be 'But does the profit-and-loss account make good reading?' The members received a bonus on business transacted with the company for the financial year ended September, 1964, which was less than three years from the start of trading operations. In 1965 the bonus was doubled, and although 1966 is still in the accounting we look forward to the future with confidence.

Statutory Grading of Horticultural Produce

Regulations prescribing National Statutory grades for apples, pears, cucumbers, tomatoes and cauliflowers sold through wholesale channels in Great Britain are to be introduced under the Agriculture and Horticulture Act 1964. The planned starting dates are as follows:

Apples, pears	17 July 1967
Cucumbers	15 January 1968
Tomatoes and cauliflowers	13 May 1968

Details of the grades, notes on their application, and details of the proposed labelling requirements have been published under the general title of '*Guides to the Grades*', as follows:

No. 1. Cauliflowers	No. 4. Tomatoes
No. 2. Apples	No. 5. Cucumbers
No. 3. Pears	

Revised editions of *Guides* Nos. 2 and 3 (Apples and Pears), incorporating amendments to the grades announced on 15th February, 1967, will be available before statutory grading begins in July.

Copies of the *Guides* may be obtained, free of charge, either from your Divisional Office of the Ministry or from (Publications), Tolcarne Drive, Pinner, Middlesex, or, in Scotland, from the Chief Marketing Officer, Department of Agriculture and Fisheries for Scotland, Government Buildings, Bankhead Avenue, Edinburgh 11.

Corporation Tax—Close Companies (Directors' Pay)

G. H. Camamile and E. S. Carter

Corporation tax—Close companies (Directors' pay)

The rules which were introduced in 1965 impose special limits on the amounts of directors' remuneration which may be set against the profits of a close company in calculating its liability to corporation tax.

Employee type directors

The restrictions do not apply to the pay of a 'whole-time service' director. This is a director who works for the whole of his time for the company in a managerial or technical capacity and who controls no more than five per cent of the ordinary shares in the company. He is virtually an ordinary employee. There are certain qualifications to this rule and each individual case must be specially examined.

Basic 15 per cent rule

The main rule is that the deduction for remuneration is limited to fifteen per cent of the taxable profits, arrived at before deducting the directors' remuneration (other than that of whole-time service directors, who are treated for these purposes as ordinary employees) and including investment income. If the accounting year or period in question shows a poor profit, or a loss, then there is an alternative. The fifteen per cent limit can be calculated on the average of the profits (similarly computed) for the preceding three years.

There will be many farming companies for which the fifteen per cent limit will give way, because of a low level of profits, to one of the two other choices which are available.

The first of these is an unqualified limit at the rate of £4,000 a year, the second a limit ranging from £7,000 to £13,000 a year where there are two or more directors who work substantially whole-time in a managerial capacity (not being 'whole-time service', or employee-type directors as described above).

£4,000 per year limit

This limit has no reference to whom the directors are or what they do, but the remuneration must, of course, actually have been due and it must have been laid out wholly and exclusively for the purpose of the business.

£7,000 to £13,000 per year limits

Where there are two or more full-time working directors for more than half the year or accounting period, the flat rate limits go up from £4,000 as follows:

For two such directors	£7,000 a year
For three directors	£10,000 ,,
For four or more directors	£13,000 ,,

Even so the deductions for the highest paid cannot exceed £4,000, and for each of the others £3,000, unless the highest paid (and only that one) gets less than £4,000. In such a case the difference between his pay and the figure of £4,000 can be added to the £3,000 allowed to another or others.

For these limits only the remuneration of the full-time working directors themselves is taken into account. No allowance can be made for the remuneration of part-time directors.

The amount of 'remuneration' includes benefits in kind which are assessed upon a director in accordance with the personal income tax rules.

To sum up—the amount deducted for directors' remuneration (other than whole-time service directors) in calculating the liability of a close company to corporation tax must be actually paid, wholly and exclusively for the purposes of the business, and within the highest in the circumstances of the following limits:

1. 15 per cent of the profits (or of the average profits of the preceding three years).
2. £4,000 per annum.
3. From £7,000 to £13,000 per annum where there are two or more full-time working directors.

Any excess paid over these limits is still earned income to the recipient, but so far as the company is concerned it is similar to a distribution of profits and costs the same as a dividend. (If this limit is preferred, only the remuneration of the full-time working directors themselves can be allowed.)

This is the eighth note in the series 'Tax in Perspective'.
A ninth note will appear in a later issue of *Agriculture*.

1966 FARM BUSINESS AWARD

The 1966 *Farm Business* Dairy Award has been won by **Mr. David Smales of Little Buckholt Farm, West Tytherley, Salisbury.** In 1963 Mr. Smales had a herd of 50 Ayrshire cows and a few followers on his 70 acres, with a 4,000 bird laying unit. Additional capital then became available and, on the advice of Lugg and Gould Ltd., Farm Management Consultants, he increased the poultry unit to 10,000 birds and the dairy herd to 70 cows. By December 1966 his herd had increased to 82 cows and is expected to reach 90 cows this summer.

A.L.S. RENT ENQUIRY

Farm Rents in 1966

FARM rents in England and Wales rose in 1966 by some 7 pei cent, continuing roughly the same annual rate of increase as in the previous four years. The latest enquiry by the Agricultural Land Service, covering about 3¼ million acres, 26 per cent of the rented farmland in the country, showed the following average rents per acre of crops, grass and rough grazing:

	October, 1965	*October, 1966*
	£ *s.* *d.*	£ *s.* *d.*
England	3 15 0	4 0 0
Wales	2 3 0	2 6 0
England and Wales	3 11 0	3 16 0

Most farm rents are paid in arrears and the rent increases recorded in the 1966 enquiry are largely the results of agreements made earlier in 1966, or, in some instances, in 1965, before the voluntary rent standstill became operative in July 1966.

Rents paid by individual tenants vary widely above and below the average of £3 16*s*. Among the many factors influencing rent levels are the quality of land, the date when the rent was last changed and the way a new rent is fixed. The enquiry provides ample evidence of the wide variation in rents from all these causes.

Landowners and agents taking part in the enquiry have classified their estates as 'lowland', 'upland' or 'mixed', as defined in their own region, and the results shown below indicate the effect of land quality on average rents.

Table 1

Average rent per acre* of crops, grass and rough grazing at mid-October, 1966

Ministry of Agriculture region	Predominantly upland estates	Predominantly lowland estates	Mixed upland and lowland estates	All* Estates
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Eastern		4 15 0		4 16 6
South-Eastern	3 15 0	4 13 6	4 5 0	4 12 0
East Midland	1 18 0	4 11 6	4 0 6	4 9 0
West Midland	2 8 6	5 5 0	4 6 0	5 3 0
South-Western	2 14 6	4 7 0	3 16 0	4 4 0
Northern	16 0	3 12 6	2 7 0	2 6 0
Yorkshire and Lancashire	14 0	4 6 0	2 5 6	3 3 0
Wales	19 0	3 1 6	2 4 0	2 6 0
England and Wales	1 4 0	4 5 0	3 17 6	3 16 0

*The figures for 'All estates' are averages of the counties in each region weighted by the total rented acreage in each county. Those for the separate categories of estate are derived from acreages and rents in each county in the sample only. Changes in the sample of estates included in the enquiry cause fluctuations in the rents shown by successive enquiries for particular regions and categories of estate.

Earlier rent enquiries have shown that rent changes have taken place on at least one in five farms every year for the five years up to 1965, so that all farms in the country might be expected to have had a new rent since 1960.

But, since rents are commonly reviewed every three or four years, some farms have had more than one rent increase during that period. There were, therefore, still farms to be found in October 1965—about five per cent of the sample, as shown in Table 2—on which the rent was to be increased during 1966 for the first time since before 1958. No doubt other such long-standing rentals are still undisturbed and continue to be part of the explanation for the disparity between the average of all rents per acre in 1966, and the higher figures which are commonly quoted as the going rate for rented farms.

Table 2

Average rent and year of previous rent change of farms with a rent change in 1966

Year of previous rent change	Percentage of farms	Average rent per acre 1965 £ s.	Average rent per acre 1966 £ s.	Percentage increase
Before 1950	1	2 11	3 16	49
1950—1955	2	2 15	5 6	93
1956	1	2 6	3 13	56
1957	1	3 18	5 9	40
1958	2	2 19	5 1	69
1959	5	2 16	3 17	38
1960	8	3 6	4 16	44
1961	17	3 5	4 5	30
1962	21	3 12	4 10	25
1963	17	3 14	4 15	30
1964	11	4 0	4 14	17
1965	14	3 12	4 2	14

The changes in rent are also analysed according to the method of rent-fixing, in the following table.

Table 3

Average rents per acre by type of rent change

Type	% of sample farms	% of total acreage in sample	October 1965 £ s.	October 1966 £ s.	% increase
New tenancy—by tender	0·3	0·4	3 13	8 5	126
—by agreement	2·3	2·9	3 12	5 1	41
Sitting tenant—by agreement	15·7	19·1	3 15	4 13	24
—by arbitration	0·1	0·2	3 1	4 5	40
All farms with a change in rent	18·4	22·6	3 14	4 15	28
Farms with no change in rent	81·6	77·4	3 9	3 9	—
All farms in sample	100·0	100·0	3 11	3 16	6·9

The average increase in rent on farms showing a change, was 28 per cent compared with 26 per cent in each of the two previous years. The small minority of farms let to new tenants by tender showed, as in most years, the largest proportionate increase and the highest average new rent. Regional variations shown by the sample in the new rents fixed by agreement, are shown in Table 4.

Table 4

Average rents per acre at mid-October, 1966, on farms with a change of rent since 1965

Ministry of Agriculture region	Rents agreed with new tenants*			Rents agreed with sitting tenants		
	Average size of farm (*acres of crops, grass and rough grazing*)	Average rent £ s.	Per cent increase over previous rent	Average size of farm (*acres of crops, grass and rough grazing*)	Average rent £ s.	Per cent increase over previous rent
Eastern	276	6 0	32	330	4 19	28
South-Eastern	277	5 14	35	271	4 18	20
East Midland	213	5 2	54	184	4 19	32
West Midland	135	6 10	47	157	5 8	20
South-Western	239	4 13	39	206	4 9	16
Northern	223	3 18	45	254	3 11	24
Yorkshire and Lancashire	114	4 17	38	149	4 16	21
England	208	5 5	40	201	4 15	24
Wales	121	2 14	61	119	2 18	34
England and Wales	198	5 1	41	193	4 13	24

*Excludes new rents by tender.

These figures, though higher than the averages of all rentals given in Table 1, conceal big variations between individual rents. Although high rents per acre are common on small farms because of the bigger proportionate influence of the farmhouse and buildings, many medium-sized and large farms are now being let at levels substantially above the average for all sizes of farm. One in twelve of all new rents reported in the enquiry were of £7 10*s*. per acre or more, ranging from one in six in the West Midlands region to only one in twenty-five in the Northern region.

The Ministry's Publications

Since the list published in the March, 1967, issue of *Agriculture* (p. 145), the following publications have been issued.

ADVISORY LEAFLETS

(*Price 4d. each—by post 7d.*)

No. 38. Mosaic and Streak of Tomato (Revised)

No. 96. Apple and Pear Suckers (Revised)

No. 177. Wheat Bulb Fly (Revised)

No. 339. Chrysanthemum eelworm (Revised)

No. 366. Ants Indoors (Revised)

No. 433. The Control of Rushes (Revised)

No. 448. The Smith Hive (Revised)

No. 495. Cream (Revised)

FREE ISSUES

STL No. 48. Business Records. Keeping Financial Records (Revised)

STL No. 53. Black Currant Leaf Spot (Revised)

STL No. 56. Keep your own Poultry Records (Revised)

STL No. 60. Spring Field Beans

Statutory Grading Horticultural Produce—

Guides to the Grades:

No. 1. Cauliflowers

No. 2. Apples

No. 3. Pears

No. 4. Tomatoes

No. 5. Cucumbers

The priced publications listed above are obtainable from Government Bookshops (addresses on p. 206), or through any bookseller. Unpriced items are obtainable only from the Ministry (Publications), Tolcarne Drive, Pinner, Middlesex.

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51. The Yorkshire Wolds

A. M. Sutherland

THE Wolds are the dominating geographical feature of the East Riding landscape. The mass of chalk which rises vertically 400 ft from the North Sea between Speeton Cliffs and Flamborough Head swings west-south-westwards in an arc to its highest point of over 800 ft near Garrowby Hill, before it turns southwards to where the Humber divides it from the Lincolnshire Wolds. On its northern and western flanks it presents a scarp edge overlooking the Vales of Pickering and York, but to the south and south-east the slope towards the Plain of Holderness is a much more gradual decline. The whole area, covering some 300,000 acres, constitutes an elevated undulating plateau dissected by numerous steep-sided dry valleys lying in part of each of the Rural Districts of Bridlington, Norton, Pocklington, Driffield and Beverley. The two latter provide important market centres for the agricultural products of the area, Beverley being the county town of the Riding. Landlord-tenant relationships remain strong on the Wolds with eight or ten large estates occupying much of the central core of the area. These estates retain a substantial acreage in hand which is extended as suitable farms become vacant.

Until comparatively recently most of the Wolds area was farmed on classical lines, the five-course rotation of clover-corn-corn-roots-corn being well nigh universal. Sheep have traditionally been the main livestock enterprise of the area, cattle being relatively less important here than in almost any arable district in the country. Economic pressures in the last ten years have, however, led to substantial changes in the farming pattern. Although sheep are still very important, the flocks of winter fattening hoggs are now few and far between. To justify their retention at current land values, greatly increased stocking densities are being practised, and there is a move towards the winter housing of the ewe flock. A further facet of this intensification is the interest in the use of small areas of specially grown fodder crops and indoor finishing for the increased proportion of lambs, which are unable to fatten off the grass as summer stocking rates are raised. At the same time, beef production, mainly on semi-intensive systems as developed at High Mowthorpe has shown some increase, whilst more recently one or two large dairy herds have made their appearance.

The major changes in husbandry practice have revolved round the cereal crops. Few areas in the country are better suited to intensive cereal production. Farms in general are large, 350–500 acres being typical, with few below 150 acres. Enclosure came late to the Wolds, the inspiration and example of Sir Tatton Sykes, the famous Squire of Sledmere, at the end of the eighteenth century marking its zenith. His improvements bore a distinctive pattern with the homestead protected by shelter-belts, and large fields of regular shape which have provided an excellent base for mechanization. Here machinery can fulfil its true function of labour substitution, most farms operating with less than half their pre-war staffs despite greatly increased outputs. The climate is favourable for cereal production, normal annual rainfall being in the range of 27–30 inches, though the exposure and large size of the fields present a serious wind hazard to ripe corn. The openness of the terrain also leads to acute snow drifting problems, with extensive drifts near hedges, which sometimes delay spring operations.

When the five-course rotation held sway, it was often difficult to maintain the full 60 per cent of corn which the rotation allowed, but today farms are commonly running between 70 and 80 per cent cereals, and many exceed this figure. Continuous corn-growing as such is seldom practised, except on isolated fields, but runs of five to eight years of corn with a short ley break is now frequently the pattern. Alternatively, the basic five-course rotation has been greatly modified by the reduction of the rootbreak to a token acreage, the land released being devoted to cereals. Whilst economic factors have undoubtedly been the main causal agency behind the revolution, the influence of the work carried out at the N.A.A.S. Experimental Husbandry Farm at High Mowthorpe has been strong. Much of its experimental programme has been geared to the cereal crops, the results of the Continuous Barley and the Straw Disposal Trials having had a considerable local influence. Both have shown the possibilities of intensive cereal production, but though the findings are accepted and practised, many would feel happier if they could introduce some worthwhile break crops into their cropping plans. Ware potatoes and sugar beet are scarcely a proposition on the general run of farms due to soil and labour conditions. On the other hand the area grows a major part of the 'S.S.' and 'A' grades of certified seed potatoes in England—and the acreage is expanding. The High Wold Seed Growers Association, has been formed to handle and market the produce from members' farms and modern storage and grading premises have been erected near Pocklington. Herbage seed growing and beans are adopted on a limited scale.

In close proximity to Hull, a new vista has opened with the prospects of a national processing firm offering contracts for peas and Brussels sprouts for freezing. Until now farmers on the Yorkshire Wolds have been unable to participate in cropping of this type which is so well established in comparable conditions across the Humber. There will be high hopes that as time passes on the range from which crops can be drawn will be extended.

Tree Planting on Waste Land

R. H. Llewellyn
Agricultural Land Service

In order to make the best use of available land in our countryside, agriculture and forestry ought to be closely integrated.

There are many instances where woodland should be grubbed out and the land brought into agricultural use. Not every farmer can afford nor may want to carry out such expensive jobs; on the other hand there must be many areas on our farms where land which is marginal or even completely uneconomic for agricultural use could be highly productive under trees.

The number of farms on which there is no waste land at all must be negligible. The census of agricultural land does not give any indication of the total acreage. But a drive in the country or better still a journey by rail will soon show many hundreds of acres which could be much better used than they are today. They are no more than 'room out of doors' and they contribute nothing but trouble to the farming community. Many farms have areas of land such as disused gravel pits, unproductive scrub, old defence installations from two world wars, rough pasture liable to flooding and so on. And today there is the increasing acreage of land covered by disused railways, land cut off by road widening and straightening. Countless other examples readily spring to mind.

Of course, much depends on the particular part of the country. In the hills there is literally no problem in finding thousands of acres of land covered with bracken, almost invariably infested with sheep tick, and wet land infested with liver fluke. Flockmasters should be glad to lose these to trees because the flocks would benefit enormously.

In the lowlands the situation is rather different because here most of the trouble is due to man's own actions. One has only to look at the unproductive waste land near towns and adjoining highways to see what happens.

It is in areas such as these that the planting of trees should be seriously considered. In some cases this may well be totally uneconomic. But the total gain to the amenities and hence the attractiveness of the countryside is immeasurable. There are also other advantages to the farmer himself. For example, woodland can be very helpful in providing shelter for stock and crops, house and buildings. Equally it is possible substantially to modify the local climate—for example modifying the effects of frost, wind and sun. The

Waste wet ground planted with poplars

effect upon wild-life conservation and sporting cannot be over-emphasized, particularly today when so many of our hedges are disappearing.

Lastly, the demand for labour in these planted areas fits in very well with normal farming life, particularly in arable districts. And, of course, there is never the same urgency of work with trees as there is with livestock. Work in the woods can always be fitted in to the odd half days.

The choice of what to plant is obviously governed by soil type, rainfall, elevation and exposure of the site. These factors vary considerably from place to place. Therefore, anyone intending to plant up land should get expert local advice on the subject from the Agricultural Land Service (usually located in the local Divisional Offices of the Ministry). If larger areas are to be tackled then the local Conservator of Forests of the Forestry Commission should be consulted. It should not be forgotten that in many cases financial assistance may be obtained both through government grants and by favourable tax concessions.

There are, however, pitfalls to be avoided; for example, tree roots can cause tremendous damage to drainage systems, watercourses and buildings. The importance of obtaining expert advice cannot, therefore, be over-emphasized.

People often think that many years must pass before trees attain their full effectiveness for amenity, shelter or productivity. But this is not so. Given the right conditions, suitable species and careful attention, trees grow quite quickly. Frequently beneficial effects become obvious only a very few years after planting. After only ten years even more obvious effects and benefits become apparent.

We have inherited a countryside that most consider beautiful, to a great extent due to the planting of trees by our ancestors. Do we not have a moral obligation to preserve, if not improve this inheritance for the benefit of our children?

Books

The Veterinary Annual 1965–66. Edited by W. A. Pool. John Wright and Sons, 1966. 63*s*.

The *Veterinary Annual* renders an inestimable service to the profession in providing each year a digest of recent advances in the various aspects of its work. As in previous years the major part of the 1965–66 edition is devoted to a review of current literature undertaken by specialists in the particular topics and culled from several thousand references. The subjects covered extend from bacterial diseases to those caused by fungi, viruses, protozoa and parasites and on to metabolic and reproductive disorders and neoplasms. There are sections on radiation, animal husbandry, surgery, public health and notable legal decisions. Pharmacology and therapeutics are flanked by an appendix on synonyms of drugs and a contribution by manufacturers of succinct descriptions of their new products.

In this wealth of information it is difficult to pick out matters for special comment but under bacterial diseases there is an excellent concise review of the current position about bovine mastitis. The attack on this disease is rightly veering from therapy to prevention, but a full account is given on the problems associated with antibiotics. The article on brucellosis is particularly topical in view of the imminence of the Ministry's control scheme. Under virus diseases—a section which has been understandably increased and now extends to nearly a quarter of the whole volume—there are articles on virus classification, concentration, purification and histological diagnosis. Other contributions include those on the threat of African swine fever, equine influenza (Newmarket cough) which received very considerable publicity in 1965, and the currently successful programme on the eradication of classical swine fever in Great Britain—a disease which has been the bugbear of the pig industry in this country for over 100 years.

The general section of the Annual, which includes papers on fluorosis, canine neurology, psychology in the life of a veterinary surgeon and radiation hazards is much lighter reading but none the worse for that.

As usual, the general index is excellent but possibly the editor might consider, in future years, publishing a list of the contents at the beginning of each chapter and not merely the authors' names which, anyway, are separately given along with their addresses.

The Editor, with the other 42 contributors, have again made a masterly job and have produced a volume which will be of great value to veterinary surgeons. Whilst it is not likely to be of constant interest to the farmer—although it would certainly stimulate him—it should find a place in any self-respecting agricultural library.

J.W.R.P.

The Daffodil and Tulip Year Book, 1967. The Royal Horticultural Society. 21*s*.

In England and Wales 8,000 acres are now needed to grow enough daffodil flowers and bulbs to cater for popular demand. The cosmopolitan flavour of the 1967 Daffodil Year Book suggests that such esteem is not confined to this country but is becoming world wide. But the casual purchaser of a bunch of daffodils might well be astonished to find that flowers so different in colour, size, shape and habit as those so beautifully portrayed on the dust-wrapper are indeed daffodils, indicating as they do, the diversity of the contents of this book.

The range of horticultural interest passes well beyond records of exhibition daffodils although these are the chief interest of many contributors. The fortunes of individual cultivars can be traced through the show benches of the world and several notable raisers such as Grant E. Mitsch recount their experiences. White daffodils, predilection of a number of English and Irish raisers are discussed in another article and accounts of New Zealand shows reveal the continued success of pinks in that country. Miniatures retain their popularity in the United States, where show quality, especially smoothness and now 'axis balance', has come to the fore. It is pleasing to find, however, that contributors are not entirely absorbed in new cultivars costing several pounds a bulb, but are at pains also to mention those of modest price which produce flowers of exhibition quality or are good garden plants.

Commercial daffodils are not considered. In an interesting article by Matthew Zandbergen that primarily records the saving of daffodil growing fifty years ago when J. K. Ramsbottom established eel-worm control, 'Carlton', never of show quality, is mentioned as top of the poll in world acreage. Things may change; Miss B. Fry of Rosewarne Experimental Horticulture Station forecasts that 'Saint Keverne' will hold this position 30 years hence—the time needed for a new introduction to become a market flower. L. W. Wallis also from Rosewarne, ably translates the results of field-scale fertilizer experiments into recommendations for private practice.

Tulips occupy a minor position. A number of *Greigii* and *Kaufmanniana* cultivars which received awards at Wisley are described. These hybrids, noteworthy for the brilliant interior of the flowers, recall a tulip feature forgotten for nearly a century but surviving in the English florists' tulips, the speciality of the Wakefield Show, which is also described.

Alstroemerias form the subject of a short but useful reference article while botanical interests are served in a more erudite account of the taxonomy of *Galanthus*.

An outstanding feature of the Year Book are the illustrations; the high standard of both the coloured and black-and-white plates, although now almost taken for granted, calls for unstinted commendation.

K.H.J.

Agricultural Physics. C. W. ROSE. Pergamon Press, 1966. 21*s*.

This book is not about a special kind of physics, but as the author points out, it gives a consideration of agricultural topics from a physical point of view. The scope of the material included is wide, ranging from a discourse on the natural sources of energy for plant growth and micro-meteorology of the agricultural environment to a treatment of soil water and soil-plant water relationships. Perhaps the chief merit of this work lies in its wide compass as few, if any, books are to be found which bring together so many related subjects. For the agriculturist and biologist whose mathematics are rudimentary or rusty, several chapters will be hard going or even incomprehensible, but for the mathematically inclined who want a concise account of the systems and problems exercising the minds of physicists in agriculture and their elucidation, there is much of interest.

The gap between fundamental scientific investigation, and the practical application of results to problems is wide in many applied sciences but rarely wider than in agricultural physics. The reasons for this are diverse, but one of the most relevant is surely that the problems tackled by research physicists are frequently not identified with current problems in the field. This book emphasizes the gap for it gives little indication that agricultural physics will make a significant contribution to the agricultural industry in the immediate future; rather its aim is to give a rational explanation of observed phenomena.

There are four sections. The first describes the physical factors which control the micro-meteorology of crops, and goes into details of interchange of heat and water at the earth's surface. The second deals with soil physics, particle size, properties of the clay fraction, and soil structure. Unfortunately, there is little suggestion that Dr. Rose is interested in the important practical aspects, such as the soil factors other than texture, which predispose some soils under arable systems to very much reduced yields. Soil water is the subject of the next two sections, first the soil-water system is considered in equilibrium using the concept of potentials, then the physics of water movement through soils is explained and Darcy's equation introduced. These two sections give a concise account of this complex subject, in which mathematical rather than descriptive models predominate. The last section gives an insight into the transport of water from the soil into and through the plant, indicating the various physical resistances to movement encountered in the system.

This work is a welcome addition to the agricultural library and one hopes that it will stimulate research into those problems in agriculture which are occupying the attention of farmer and adviser alike.

D.B.D.

Dorset: A Shell Guide. MICHAEL PITT-RIVERS. Faber and Faber, 1966. 21*s*.

Dorset is a compact, relatively unspoiled rural county, full of interest to inhabitants and visitors. Its soils, topography and coastline give it a variety almost unsurpassed. Its attractive landscape and inspired architecture appeal to the eye. The archaeological and historical interests are un-

limited. The author, together with the acknowledged help of many others, is well qualified to produce this guide and bring it up to date. It should be valuable to those who wish to know Dorset better and delve into its mysterious past.

The opening chapter, 'The Face of Dorset', in which Paul Nash describes the landscape, has been reprinted almost in its entirety from the first Shell Guide to Dorset in 1935, and rightly so. In it he describes the geographical areas. In the introduction to the gazetteer the author has dealt further with the landscape and paid particular attention, in a well condensed form, to the varied architecture centred on its 'profusion of handsome and elegant houses', and churches. In a subsequent short chapter, Roger Peers traces the history of Dorset from prehistoric times through its rich archaeological treasures such as tumuli, dykes, lynchets and earthworks, flints and hill-top camps.

The gazetteer has been brought up to date and the numbered place names can easily be found on the quarter-inch map reproduced in the front of the book. The stranger should be able to find them without difficulty. It describes the setting, architecture and sometimes the histories of the families connected with the numerous named places of interest. Where they are of historical or archaeological significance, the appropriate reference is made. It is full without being complete. The more popular places of interest such as Corfe Castle or Lulworth Cove are not over emphasized. The illustrations are particularly good and of immense souvenir value. Their quality and variety do full justice to all aspects of the county.

This is not a farming book but those who live by, and have an interest in, the land in Dorset should find it revealing. Those who wish to pursue the many interesting facets of the county will find it a helpful guide.

M.J.B.

Environmental Biology, Vol. 4. R. F. MORGAN. Pergamon Press, 1966. 10*s*.

This is the most advanced of the series intended ' . . . primarily as a four-to-five year course leading to Ordinary level in biology, rural biology and agricultural science'. It continues the course from Assignment 73 with studies on plant and animal control and sensory systems, terminating with chapters on reproduction and heredity, including one on the genetic code.

It is more theoretical than the third volume, and better suited for the more mature student, though experiments are again written into the text to maintain the practical approach. The experiments suggested will be found most useful, but it is hoped that the caponization of cocks with stilboestrol by schoolboys does not indicate an infiltration into our system of some of the cruelty experienced by animals in American science teaching, and the experiment on p. 62 does not prove what it claims: that sound travels further in solids than in air.

It is a healthy sign that man has replaced the rabbit in the section on mammalian reproduction, and two pages have been added on Western sexual morality and the family unit, which may not be appropriate to all taking the Commonwealth and International Library, to which this series belongs.

On occasion this volume gives the wrong emphasis, such as that worms have to live underground because they have no eyes and that man is automatically the most advanced animal, when he only excels in cerebral development and dexterity. Pupils may be interested to know that, contrary to the statement on p. 119, males of many species of mammal do not produce sperm throughout the year.

These points do not detract from the value of this volume as a teaching and practical book, which continues the active approach of the previous three in the series.

J.C.T.

United Kingdom Dairy Facts and Figures, 1966. The Federation of United Kingdom Milk Marketing Boards.

There is very little concerning the statistics of the production and distribution of milk and milk products in the United Kingdom that is not contained in this handy guide. Total milk production in 1965-66 was at 2,444 million gallons, four million gallons more than in 1962-63. But the credit for this goes to Northern Ireland; England, Wales and Scotland produced less.

The milk 'drain' of registered producers topped 17,200 all told—14,600 in England and Wales, 900 in Scotland and 1,700 in Northern Ireland.

The astounding increase in the U.K. consumption of liquid milk, which before the war stood at 168 pints per head, per year, moved still higher in 1965 to 252 pints. In three years the total U.K. market for

liquid milk and fresh cream has increased by 70 million gallons to 1,758 million.

On average a housewife spends 9 per cent of her total weekly food bill on milk. Sales of fresh cream have rocketed, largely due to the development of self-service stores with refrigerated dairy sections. One hundred and four million gallons of milk in England and Wales and 8 million gallons in Scotland went to its manufacture in 1965-66.

An increasing number of dairy farmers are investing in labour-saving dairy equipment. By March 1966, 9,000 had refrigerated 'bulk' tanks, and 17 per cent of the milk supply is now transported in over 500 farm tankers—three times as much as three years ago.

Like our daily bread, the daily 'pinta' is taken very much for granted. It is by such a mass of information as is given in this handy-sized book that something of the productivity of our dairy industry and the efficiency of the organization that brings milk from udder to doorstep begins to be appreciated—or should be!

Copies of this report may be obtained from the Milk Marketing Board, Thames Ditton, Surrey, price 7*s*. 6*d*.

S.R.O'H.

Animal Ecology. Charles Elton. Methuen, 1966. 13*s*. 6*d*.

For forty years this book has been basic reading for students of the subject and it is a great pleasure to have it now more widely available in a paperback edition. The text is virtually unchanged, apart from an additional preface, which refers to the main trends in animal ecology in recent years, and some extra references.

Now, as in the early 1920s, the author is much concerned with ecological survey and especially with the ecology of communities, although paying due regard to the study of populations of individual species. For animals to be accurately identified, work in museums is necessary, but first-hand knowledge of how animals live can be acquired only by diligent field work. This book sends the student out into the countryside, to study the distribution of animal communities in different habitats, the workings of ecological succession and the factors in the environment which limit an animal's activities.

Attention is given to the now familiar principles of food-chains and food-cycles, the niche occupied by an animal in a community and the pyramid of numbers, with an abundance of animals at the base and only a few at the apex. A discussion of the rhythms of the environment—of day and night, the tides, weather, and the annual cycle of the seasons—and their effects on animal communities stimulates thought about the complexity of patterns of behaviour and variations in numbers of animals.

The mechanisms by which animal numbers are regulated have been much studied over the last four decades and have given rise to many controversies. But the author's two chapters on the subject still provide a very useful, discerning introduction.

Space is also given to means of dispersal of animals, methods employed in ecological work and, finally, to the contribution that ecology can make to the study of evolution. The great variability of populations and habitats is strongly impressed on the reader and it is most appropriate that the complexity of animal communities should form the subject of Elton's most recent book.

H.V.T.

Books Received

Documentation in Agriculture and Food, No. 86. Higher education in agriculture. Organisation for Economic Co-operation and Development, 1966. 22*s*. 6*d*.

Ventilated Chitting Houses. Experimental Farm Buildings Report No. 6. H. J. M. Messer, G. P. Franghiadi and J. T. R. Sharrock. National Institute of Agricultural Engineering, 1967. 4*s*. 6*d*.

Partially Slatted Floors and Floor Feeding in Pig Fattening Houses. Experimental Farm Buildings Report No. 8. H. R. Livingston and A. M. Robertson. National Institute of Agricultural Engineering, 1967. 4*s*. 6*d*.

Building for Food Storage and Direct Feeding of Cattle. Experimental Farm Buildings Report No. 9. H. J. M. Messer and J. M. Hill. National Institute of Agricultural Engineering, 1967. 7*s*. 6*d*.

Sugar Beet Production and Harvesting. A report on surveys of the 1965 crop in the Eastern Counties. B. G. Jackson and J. G. Davidson. Copies from Farm Economics Branch, School of Agriculture, Cambridge, 5*s*. (including postage).

Risk, Uncertainty and the Instability of Incomes in Agriculture. Occasional Paper No. 2. J. A. Langley. University of Exeter, 1966, 5*s*.

The Impact of Tower Silos on Grass Conservation and Grain Storage. Report No. 160. V. H. Beynon and Carol A. Godsall. University of Exeter, 1967. 5*s*.

Agricultural Chemicals Approval Scheme

Since the publication of the 1967 List, the following products have been approved:

FUNGICIDES

ZINC, MANGANESE, COPPER AND IRON DITHIOCARBAMATE COMPLEX

For control of potato blight and hop downy mildew.

Wettable Powders

Cufram Z—Universal Crop Protection

HERBICIDES

IOXYNIL

Ioxynil is now approved for general weed control on new lawns sown from seed during the period of early establishment.

Sodium Salt Formulations

Actrilawn—May and Baker

MISCELLANEOUS

N-DIMETHYLAMINO SUCCINAMIC ACID

A chemical height retardant for chrysanthemums under glass including those grown in pots.

Liquid Formulations

B-Nine—Mirvale

Company Information

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